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Deliverable D1.5

Common Course Program and Integration Activity Report

The EMANICS Consortium

Caisse des Dépôts et Consignations, CDC, France
Institut National de Recherche en Informatique et Automatique, INRIA, France
University of Twente, UT, The Netherlands
Imperial College, IC, UK
Jacobs University Bremen, JUB, Germany
KTH Royal Institute of Technology, KTH, Sweden
Oslo University College, HIO, Norway
Universitat Politecnica de Catalunya, UPC, Spain
University of Federal Armed Forces Munich, UniBwM, Germany
Poznan Supercomputing and Networking Center, PSNC, Poland
University of Zürich, UniZH, Switzerland
Ludwig-Maximilian University Munich, LMU, Germany
University College London, UCL, UK
University of Pitesti, UniP, Romania

For more information on this document or the EMANICS Project, please contact:

Dr. Olivier Festor
Technopole de Nancy-Brabois - Campus scientifique
615, rue de Jardin Botanique - B.P. 101
F-54600 Villers Les Nancy Cedex
France
Phone: +33 383 59 30 66
Fax: +33 383 41 30 79
E-mail: <olivier.festor@loria.fr>

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E-mail:	gabi.dreo@unibw.de
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0.6	2009-01-13	Gabi Dreo Rodosek	Summary, Introduction, Conclusions

Contents

1 Executive Summary

Since the objectives of work package 1 are to document and foster the integration and collaboration among EMANICS partners, to enhance the visibility of EMANICS and to develop an initial a common course program, as documented in the JPA, deliverable D1.5 reports on the achievements of these tasks in the last reporting period. Two tasks are especially outlined, namely the involvement of EMANICS in the activities of the Future Internet to increase the visibility of EMANICS, and the analysis of the impact of social networking among IT researchers as a means of collaboration.

The common course program on the master level in network and service management, as reported already in D1.4, has been extended with new teaching material from the area of ”Economic management - Charging and Accounting of IP services” and in ”Advanced Topics in Policy-based Management, Context-Awareness and Ontologies in Network and Service Management”.

Social networks are a quite emerging means of collaboration among people, and may operate on several levels (e.g., researchers, friends, families). They play certainly a role in determining the way problems are solved and organizations are run. Since collaboration is one of the objectives of work package WP1, it was quite obvious to take a closer view on social networks as well. Thus, one activity in WP1 was to analyze the impact of social networks by first designing a questionnaire firstly, secondly, to gather the necessary data, and thirdly, to perform an evaluation of the results. Besides, requirements for social networks from the perspective of IT researchers have been derived, and documented as well.

Deliverable D1.5 reports also on several EMANICS activities in the area of Future Internet. The organization and the leading of the ICT networking session “Management Challenges of the Future Internet” in Lyon, a special issue of the IEEE Communications Magazine on “Management of the Future Internet”, the organization of a Dagstuhl seminar on ”Management of the Future Internet”, and the co-organization of the workshop “Management of the Future Internet”, co-located with the 11th IFIP/IEEE International Symposium on Integrated Management in New York are some of the activities to mention. Important observations during the involvement in these activities have been that (i) management is crucial for the success of the Future Internet, and (ii) that it is necessary to think about management from the very beginning of the design of the Future Internet. D1.5 documents comments and outputs related to these activities.

Finally, deliverable D1.5 covers the deployment of the EMIN tool, a tool to document and report the integration among EMANICS partners. Improvements have been made towards mechanisms to gather and evaluate data as far as possible in an automatic way and to minimize the necessary manual input. Besides, D1.5 reports on the development of a common taxonomy for network and service management that was proposed and accepted by the IFIP WG 6.6, IEEE CNOM and IRTF-NMRG as well as the results achieved in indexing DBLP.

2 Introduction

Within the last reporting period work package 1 has continued to work on its tasks as defined in the JPA. Table 1 provides an overview of the projects during the last reporting period.

Table 1: Work package 1 (WP1) projects, and partners involved

Full Project Title	**Partners**
EMANICS Workshop "Vision and Management of the Future Internet"	UniBwM, IUB
Indexing DBLP	UT, INRIA
EMANICS Integration Reporting Tool	UniBwM
Taxonomy of IT network and service management	UniBwM, UT
Social Networking among IT Researchers (SONATA)	UZH, UniBwM, UT
Common Course Program - Part II	UniBwM, UPC, UCL

Deliverable D1.5 reports on the outcomes of these projects. Besides, activities with respect to visibility, and thus the achievements resulting from EMANICS being involved in the Future Internet activities are reported in D1.5. For example, EMANICS proposed an ICT networking session on "Management Challenges of the Future Internet", which was accepted by the EU and organized by EMANICS. At the networking session several projects, EMANICS, SmoothIT, AutoI, 4WARD and Trilogy, presented their views on the Future Internet and the resulting management challenges. The discussion afterwards in the panel as well as the comments of researchers left on the ICT web site have lead to two main conclusions:

- Management of the Future Internet is important; it is crucial for the success of the Future Internet!
- We need to think of Management from the beginning; Management must not be added as an "afterthought"!

Deliverable D1.5 reports also on other activities related with the Future Internet such as the presentation of the EMANICS view – outcomes of the EMANICS Workshop "Vision and Management of the Future Internet" – about management challenges of the Future Internet at the EuroView 2008 in Würzburg.

2.1 Document Outline

Deliverable D1.5 is organized as follows, fully in-line with the JPA and the Phase III project-based operation of EMANICS. Section 3 documents the activities with respect to the common course program, and includes new teaching material that has been produced in the area of "Economic Management - Charging and Accounting of IP Services" and "Advanced

Topics - Policy-based Management, Context Awareness and Ontologies in Network and Service Management". The activities related with SONATA, the analysis of the social networks – which include the (i) design of the questionnaire, the (ii) gathering of the necessary data, an (iii) analysis of the data, and finally (iv) some observations and conclusions made – are reported in Section 4. A report on the EMANICS involvement in Future Internet activities is included in Section 5. This sections documents also the outcomes of the activities. And finally, section 6 documents the activities and outcomes on the tasks related to the EMANICS integration graphs (EMIN), the deployment of the world wide research map, the taxonomy and indexing of DBLP. Section 7 summarizes the main points.

3 Common Course Program

WP 1 supported the creation of teaching material fit for the defined Master's program on network and service management. Course material has been generated for the course "Economic Management - Charging and Accounting of IP Services" in the form of commented course slides that are available to all EMANICS partners in the project's teaching repository. The second course "Policy-based Management" consists of different material as it is taught in another way; excerpts from text books and white papers are discussed in class.

3.1 Economic Management - Charging and Accounting of IP Services

This teaching material (module) aims at providing a set of slides for 8 advanced lectures on Economic Management, especially on charging and accounting of IP services. Each lecture is supposed to last 2x45 minutes. The teaching materials are suitable for PhD level, since they also consist of results or approaches of current research activities.

3.1.1 Module Description

Economic management is one of key topics in the research on IP service management. Therefore, following lectures are designed to provide PhD students interested in this research area with a good basis for performing further research:

1. Introduction to Economic Management of IP Services: This first lecture motivates the whole course and introduce key terms and definitions.
2. Economic Traffic Management: This lecture discusses the problems of traffic management, describes economic principles, introduces IP QoS, and explains mechanisms to manage overlay traffic in an incentive compatible way.
3. Pricing: Various pricing schemes are discussed including usage-based, flat fees, Cumulus Pricing, priority pricing, and auction pricing. Their characteristics are explained and compared.
4. SLA Compliance Auditing
5. Usage and Performance Measurement: In this lecture, measurement methods are explained, both for usage as well as performance measurements of certain metrics chosen.
6. AAA and Security: Authentication and Access Control are crucial in delivering IP services. Thus, this lecture is dedicated to issues on security related to IP service consumption including identity management, AAA approach, and non-repudiation mechanisms.

7. Pricing and Accounting in P2P Networks: This lecture comprises two parts. In the first part, P2P market management is discussed together with an example approach called PeerMart, a decentralized auction-based market. In the second part, decentralized accounting schemes are explained.
8. Accounting in Grid Environments: This lecture addresses accounting in dynamic virtual organizations in grid environments, in particular it addresses the grid service model, accounting requirements, and taxonomy of grid resources.

3.1.2 Outline

The following list gives an overview of the structure of the course.

1. Introduction to Economic Management of IP Services
   (a) Motivations and View Points
   (b) Basic Terms and Definitions
2. Economic Traffic Management
   (a) Challenges
   (b) Economic Principles and Pricing
   (c) QoS and Traffic Classes
   (d) Time Scales
   (e) Economic Management of Overlay Traffic
3. Pricing
   (a) Introduction
   (b) Usage-based Pricing Scheme
   (c) Flat Fees
   (d) Cumulus Pricing Scheme
   (e) Pricing Expected Capacity
   (f) Priority Pricing
   (g) Responsive Pricing and Auction Pricing
4. SLA Compliance Auditing
   (a) Definition of Terms
   (b) Sample scenarios
   (c) Auditing systems for different types of SLA
   (d) Auditing of Multi-domain IP carrying SLA
      i. Special problems
      ii. Architecture

(e) Conclusions

5. Usage and Performance Measurement
   (a) Introduction
   (b) Metrics
   (c) Time and Synchronization
   (d) Simple Network Management Protocol (SNMP)
   (e) NetFlow and IPFIX
   (f) Sampling
   (g) ICMP
   (h) ITU-T E-Model
   (i) Perceptual Evaluation of Speech Quality (PESQ)
6. AAA and Security
   (a) Introduction
   (b) Identity Management and Single Sign On
   (c) IETF AAA Approch
   (d) Ax Approach
   (e) Non-repudiation of Service Consumption
7. Pricing and Accounting in P2P Networks
   (a) Peer-to-Peer Market Management
      i. Main Problems and Requirements
      ii. Architecture
      iii. Peer-to-Peer Middleware
      iv. PeerMart
   (b) Decentralized Accounting
      i. Incentive Patterns
      ii. P2P Accounting
      iii. Token-based Accounting
      iv. PeerMint
8. Accounting in Grid Environments
   (a) Introduction
   (b) Service model for Virtual Organizations
   (c) Requirements of accounting in DVOs
   (d) Status Quo: Accounting in Grid environments
   (e) Taxonomy of Grid resources
   (f) Example: Accounting of complex Grid services
   (g) Summary

3.2 Advanced Topics - Policy-based Management, Context-awareness and Ontologies in Network and Service Management

3.2.1 Course Objectives

- To understand the policy based management paradigm as a way to manage networks and services
- To learn the tools used to represent and analyze policies

3.2.2 Outline

The following list gives an overview of the structure of the course.

- The policy based management paradigm
  - Objectives pursued
  - The ECA policy concept
  - Policy formalisms. Models and languages
  - Policy-based management system architecture
- Models overview
  - The CIM and PCIM
  - Policy modelling in the TMF SID
  - The DEN-ng policy model
  - Context for policy decision
  - Ontology engineering for context and policy modelling
  - The policy continuum
- Policy languages
  - XML for policy description. Examples
  - Ponder policy language overview
  - Other policy languages
- Policy refinement
  - Goal oriented policy refinement
    - Abductive reasoning
    - Model checking based
  - Other approaches
- Policy conflict detection and resolution

  - Conflict typology and detection mechanisms
    - Topologic spaces, precedence rules, logic programming, databases
  - Conflict resolution based on FSTs
- Example scenarios
  - Generic management system implementation
  - Management of IP/WDM networks
  - Management of the Grid
  - Management of a video streaming service
  - Management of context-aware services
- The policy based management paradigm in the industry
- Policy standardization bodies and fora

3.2.3 Course Readings

Title	Author	Publisher	Year
Policy-based Networking	D.C. Verma	New Riders	2000
Policy-based Network Management	J.Strassner	Elsevier	2004
Proposal Of A Model For The Management Of Active Networks Based On Policies	J.Vivero	PhD thesis	2003
Finite State Transducers For Policy Evaluation And Conflict Resolution In Autonomic Communication Systems	J.Baliosian	PhD thesis	2005
A Methodological Approach To Policy Refinement In Policy-Based Management Systems	J.Rubio	PhD thesis	2007

4 SONATA - Social Networking Among IT Researchers

Todays, there are plenty of social networking platforms (SNP) developed to establish relationships among specific group of people with similar interests or occupation. Such social networking platforms do also exist for business professionals, e.g., LinkedIn and XING, and many researchers are registered to these platforms. Thus, evaluating the impact of social networking platforms is important to find out collaborations between researchers in Information Technology (IT) management environments.

SONATA aims at studying the usability of these social networks and to derive requirements for a useful and effective social networking platform which is able to foster collaboration and co-operation among researchers in the IT world. The work comprises a survey on existing social networking platform for business professionals, study its utility or usefulness to IT researchers, and definition of requirements for an IT researchers social networking platform based on results of the survey.

IT researchers are asked about their participation in various SNPs. The questionnaire focuses on 4 SNPs: LinkedIn, XING, Ecademy, and Ryze. However, participants are given the chance to specify another SNP he joins and answer questions about this SNP. The questionnaire is implemented using XQuest, an online questionnaire tool. IT Professionals are then invited via emails to participate in the survey.

4.1 Questionnaire Design

To achieve a good overview and ease survey participants to answer, questions are grouped into 3 sections:

- Membership section: questions about membership in general
- SNP section: questions about each SNP, including participation intentions, usage profile, and degree of satisfaction in using features of an SNP.
- Personal data section: questions about the participant, suggestions for improvements, and further comments.

Furthermore, the questionnaire is organized in pages. The membership section contains a single page. The SNP section consists of one page per SNP, and the personal data section consists of a single page. To introduce the SONATA Activity within EMANICS to the participants, an introductory text is presented at the beginning of the questionnaire. The text reads as shown in Figure 1.

4.1.1 General Questions on SNP Membership

Table 2 lists general questions about membership of an SNP. If survey participants are not a member of any Social Networking Platform, they are requested to proceed with the last page of the questionnaire to fill in their personal data.

Figure 1: Introductory Text

Todays, there are plenty of social networking platforms (SNP) developed to establish relationships among specific group of people with similar interests or occupation. Such social networking platforms do also exist for business professionals, e.g., LinkedIn and XING, and many researchers are registered to these platforms.

SONATA (Social Networking among IT Researchers) is an activity within the Work Package WP1 of the EU project EMANICS. This activity aims at studying the usability of these social networks and to derive requirements for a useful and effective social networking platform which is able to foster collaboration and co-operation among researchers in the IT world.

Therefore, we are carrying out a survey through this questionnaire. The questions address membership types and fees, participation intention and usage profile, features of social networking platforms, and personal data. To fill in the questionnaire, 15 minutes of your time should be sufficient. Please write your comments at the end of the questionnaire if you have some. You can leave us your email address if you want to receive the results of this survey. We will only use your email address in relation to this survey. We are convinced that the result of this survey will be beneficial to all of us, since this will lead to improvements of those tools. All answers will be treated anonymously and confidentially. Thank you very much for your participation.

4.1.2 Questions about Each SNP

For each SNP, a set of questions is asked as listed in Table 3, Table 4, and Table 5. Table 3 contains questions about being membership of the specific SNP. While questions in Table 4 ask about participation intentions and usage profile, questions in Table 5 ask about features of the SNP. In Table 5 following features are of particular interest:

1. Profiles management
2. Groups management

Table 2: Membership

#	Question	Widget	Answer Choices or Check Box Labels
1	Are you a member of any Social Networking Platform?	Radio button	Yes (cont. with question 3) No (cont. with question 2)
2	If you are not a member, what are the reasons not to join any Social Networking Platforms? (More than one choice is possible)	Check box	Do not know any Social Networking Platforms Do not see any benefit to be a member Security and privacy concerns Other (please specify):
3	If you are a member, which Social Networking Platform(s) do you join? (More than one choice is possible)	Check box	LinkedIn XING Ecademy Ryze Other (please specify):

3. Contacts management
4. People search
5. Job search
6. Company search
7. Search for interests
8. Non-interactive communication service, e.g., email
9. Interactive communication service, e.g., chat service
10. Group newsletters
11. Blackboard service
12. Blog / forum
13. Group Calendar
14. Privacy protection support

4.1.3 Questions about Personal Data

Finally, Table 6 shows those questions for obtaining a picture about the IT researcher himself. In addition to that, survey participants are requested to provide suggestions to improve an SNP as well as additional comments if any.

Table 3: Membership of a Specific SNP

#	Question	Widget	Answer Choices or Text Box Labels
4	How did you learn about the social network? (More than one choice is possible)	Check box	Friends and colleagues Internet Magazine and newspaper TV and Radio Other (please specify):
5	Joined this Social Networking Platform since	Text box	Year: Month:
6	Are you a premium member? (A premium member may access exclusive services which are not free of charge)	Radio button	Yes No
7	If you are a premium member, what are your reasons for being a premium member? (More than one choice is possible)	Check box	Usage of special services Pay to support Social Networking Platforms Membership fee is low Other (please specify):
8	If you are not a premium member, what are your reasons for not being a premium member? (More than one choice is possible)	Check box	Do not want to pay Would like to, but membership fee is too high Payment method complicated Payment method insecure Do not need special services Others (please specify):
9	What is your opinion about member type and membership fee?	Radio button	Membership should be free of charge (no distinction between premium and non-premium members) All member must pay (no distinction between premium and non-premium members) All member must pay (premium members pay more) Only premium member should pay
10	What is your opinion about the amount of the membership fee?	Radio button	Low Fair High
11	How much are you willing to pay for an annual membership fee?	Radio button	Less than 10 US $ 10-50 US $ 50-100 US $ 100-150 US $

Table 4: Participation Intentions and Usage Profile

#	Question	Widget	Answer Choices or Text Box Labels
12	What are your main intentions to participate in this Social Networking Platform? (More than one choice is possible)	Check box	Publishing personal data, e.g., cv Finding and getting in contact with people that you know Finding and getting in contact with people of specific expertise / interests Exchange of expert knowledge Looking for a job Looking for an employee Staying in touch with former colleagues/friends As an address book for storing and manageing contacts Publishing and receiving information for a specific region or interest group Getting to know who is in contact with whom Other (please specify):
13	Frequency of usage	Radio button	Daily Weekly Monthly
14	Total number of relations to other members	Text box	First degree relations (members directly connected to you): Second degree relations (members directly connected to your first degree relations):
15	Number of invitation messages to establish a first degree relation	Text box	Received: Sent:

Table 5: Participation Intentions and Usage Profile

#	Question	Widget	Answer Choices or Text Box Labels
16	How important are the following features to you in this Social Networking Platform?	Radio button	Essential Nice-to-have Not needed
17	How often do you use the following features in this Social Networking Platform?	Radio button	Daily Weekly Monthly Never
18	How satisfied are you with the following features in this Social Networking Platform?	Radio button	1 (Disappointed) 2 3 4 5 6 7 (Satisfied)

Table 6: Personal Data

#	Question	Widget	Answer Choices or Text Box Labels
80	Gender	Radio button	Male Female
81	Age	Radio button	under 20 21-25 26-30 31-35 36-40 41-45 above 45
82	Region	Dropdown Box	Central Europe Eastern Europe Northern Europe Southern Europe Western Europe North America Middle America South America Africa Asia Australia
83	Occupation (More than one choice is possible)	Check box	PhD Student Professor Junior Researcher Senior Researcher System Architect Software Architect Software Developer Other (please specify):
84	Areas of expertise (More than one choice is possible)	Check box	Artificial Intelligence Communication Systems Database Distributed Systems Hardware Human-Computer Interaction Networking Security Software Developing Software Engineering Other (please specify):

4.2 Evaluation

Invitations for the SONATA questionnaire were sent out in December 2008 from UZH, UniBwM and UT to all associated computer science researchers. Within two weeks 224 questionnaires were filled out. In this section we discuss the results of the SONATA questionnaire.

It is no wonder that most of the survey participants are male. The ratio between female and male is about 1 to 8, so about 89% of all survey participants are male.

Figure 3 shows the age distribution of the participants. Here, the biggest lot of survey participants are between 26 to 30 years old, followed by the group of year old 31 to 35 people. About 65% of the participants are younger than 36 years and 54% of all are between 26 and 35. So the questionnaire addresses first of all the younger scientists, whom we suppose are using SNPs more frequently than older scientists. We will show later that the assumption is correct at least for this survey.

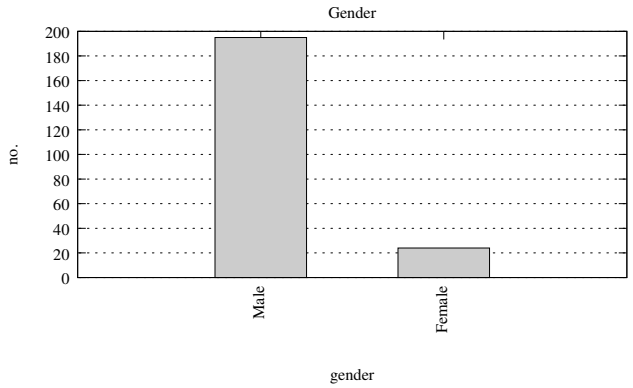


Figure 2: Gender

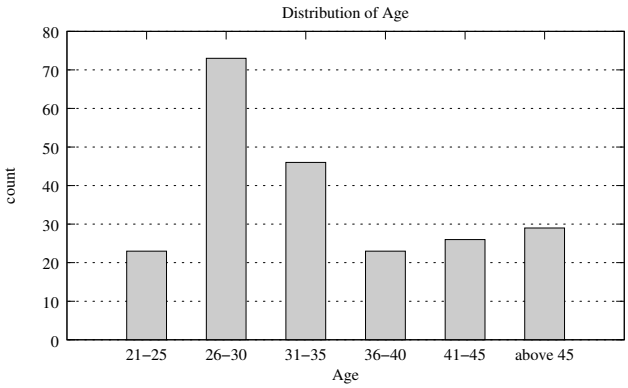


Figure 3: Age

Beside age and gender, the region could also have some impacts on the results. As Figure 4 shows most people asked live in Europe (71%) with about 76% of them living in Central and West Europe. Because of this fact, we will not further distinguish between regions in this evalution, the lot of Non-European people is too low in order to derive a meaningful statement about the impact of the region on the survey results. But we can say that this questionnaire shows the social network activity of European researchers.

One of the most important questions in the survey was the question about the occupation followed by the question on the areas of expertise. Figure 5 and Figure 6 show the results of these questions. There is an almost balance between PhD students, professors, junior-, and senior researchers. About 78% of all persons involved belong to these four groups. We will use this information to differentiate social networking usage of these groups later.

The results of the question on the areas of expertise (Figure 6) show that most people work in the field of network, communication systems, and distributed systems. This is followed by software developing and engineering. About 40 participants quote that they work in the field of computer security. Only a limited number of participants have expertise in the field of artificial intelligence and human-computer interaction. Most of the interviewed person have expertise in the field of computer engineering.

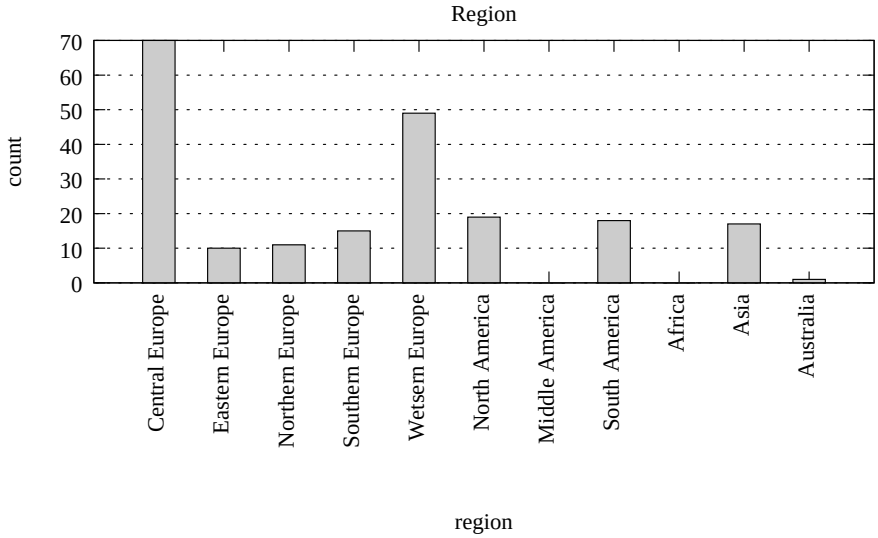


Figure 4: Region

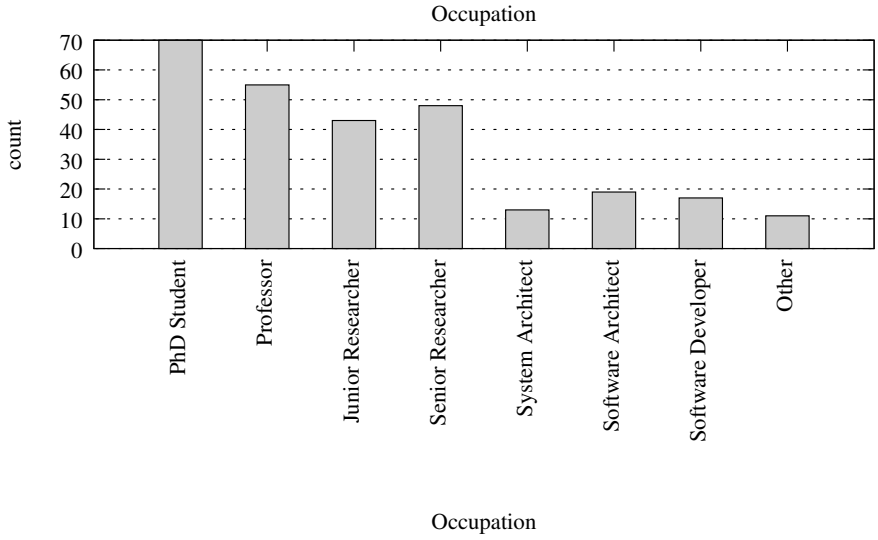


Figure 5: Occupation

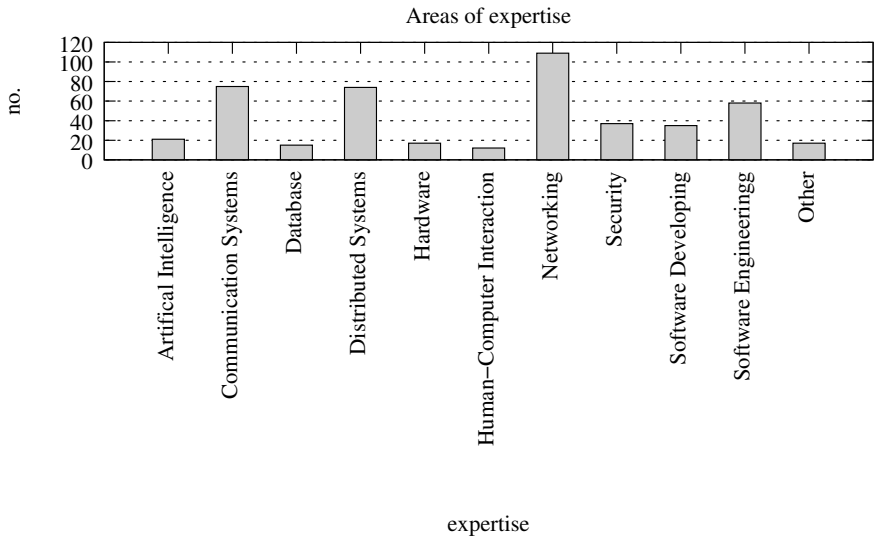


Figure 6: Areas of expertise

We further evaluate the question on whether and how many people use SNPs, and if not, why they are not using them. We found out that about 69% of the peolpe state that they are member of at least one SNP. Those people who actually are not a member of any SNP seem to have at most two points for not joining. The first point is about security and privacy concerns followed by the point that people do not see any benefit of beeing a member. Figure 7 shows the proportion of the answers. Other than that mentioned causes, some people quoted that the do not know any social networking platform at all.

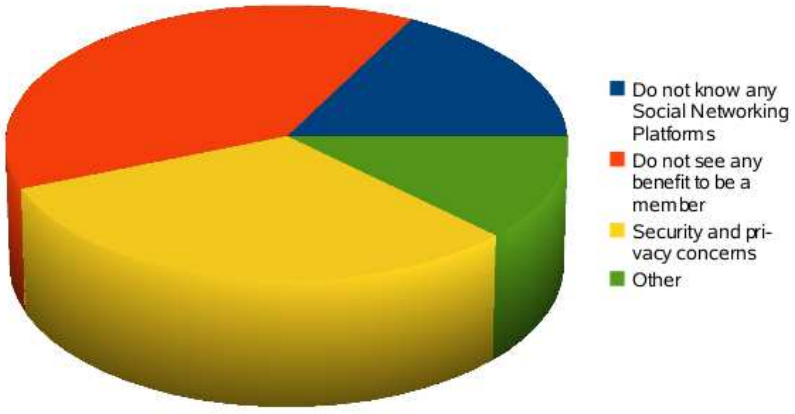


Figure 7: What are the reasons not to join any Social Network?

Those people who have joint SNPs were asked which platforms they use. The result is shown in Figure 8. More than 50% are member of LinkedIn, followed by XING and Facebook. These results correspond with the fact that the XING platform is well known in Germany but has less members outside of Germany. LinkedIn has members in all European countries and so LinkedIn has a greater degree of popularity in Europe than

XING. This consideration is reflected in the amount of SNP members we have counted. Since LinkedIn and XING are business platforms and Facebook targets the private sector, the question is whether we can make a statement about who joins which kind of platform. Figure 9 and Figure 10 show which platforms are joint by PhD students and professors respectively junior and senior researchers.

The amount of PhD students joining an SNP is significant higher than the number of professors. So students rather use SNPs than their professors. The professors state in the survey that they mostly use the LinkedIn business platform than any private social network like Facebook.

The amount of platforms joint by junior- and senior researcher are compareable to the ones by PhD student/professor. Senior researchers mostly use LinkedIn, while junior researchers also use private platforms.

But when we have a look at the total number of platforms students and professors respectively junior and senior researchers have joined, we can conclude that SNPs are more popular amoung the younger people - here students and junior researcher -.

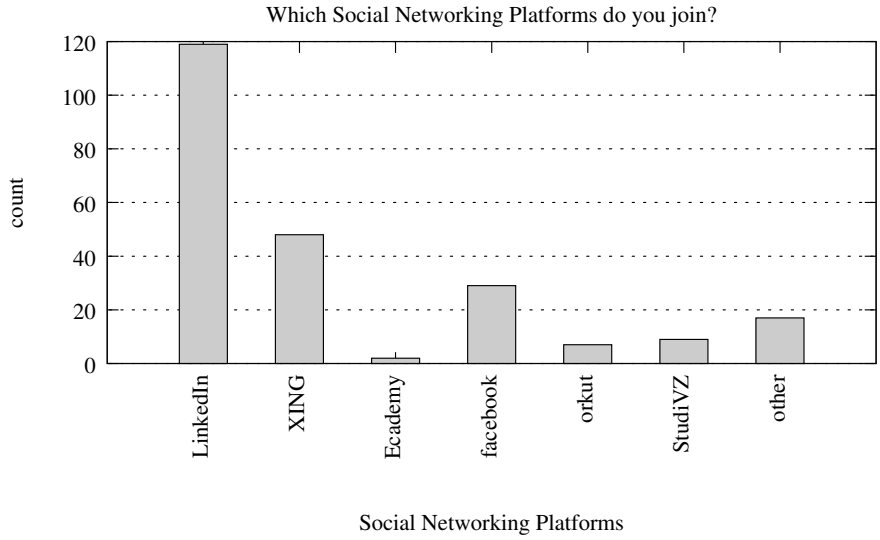


Figure 8: Which Social Network Platform do you join?

51% of all survey participants were invited to join a social network by friends and colleagues. Only 18% by internet advertisements, and as good as none by magazine, newspaper, TV and radio advertisement. One can say that mouth-to-mouth advertisement is by far the best way to promote an SNP.

Concerning the question about premium membership, over 97% are not premium member of any SNP. About 71% of these people said that they do not want to pay anything for using an SNP. About 53% further said that they do not need special, fee required services. So it is no wonder that when asked about their opinion concerning member type and membership fee, about 60% believe that the membership should be free of charge and 31% said that only premium members should pay.

About 32% of all persons asked said that the membership fee of today SNPs is too high. Nearly the same number of people think that the fee is fair. 75% of the people are willing

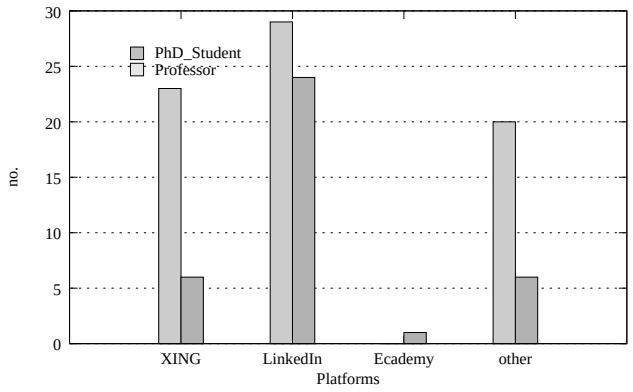


Figure 9: Which Social Network Platform do science join?

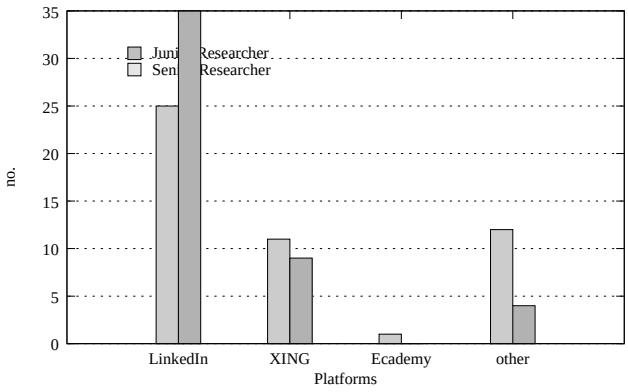


Figure 10: Which Social Network Platform do researcher join?

to pay less than 10 US$ for joining a social network.

Regarding participation intentions, most people answered that they wanted to stay in contact with people they know or with people of specific expertise or interest. Some use the social network as a kind of address book, other for publishing personal data. The option to use an SNP as a kind of job search exchange platform is not so pronounced, at least not under researchers. Asked about how frequent social networks are used, 54% use it monthly, and about 40% at least weekly.

Concerning the importance of available features of today SNPs, people said that the essential features are profile management, contact management, people search, and privacy protection support. Features like job, company search or search for interests have only a secondary role. Available communication features like chat or intra-email were considered as not needed. This shows that most people use SNPs as a kind of online address book and not as a communication platform or groupware replacement. Possible connections to job search platforms, or search databases for like-minded person are conceivable, but seem to be not promising in scientifically used SNPs.

4.3 Requirements Derived from the Questionnaire

As stated in the beginning, the main purpose of this questionnaire is to derive requirements for an SNP for IT professionals, in particular for IT researchers. Based on the evaluation results, in order to gain members, an SNP for IT professionals needs to meet the following requirements:

- Security and privacy support: This is one of the main concerns why an IT professional does not want to join an SNP. An SNP must protect the privacy of its members and provide secure handling of members' data.
- Low fee for premium membership: Although charging for premium membership is acceptable, the annual fee should be low, e.g., below 10 US$
- Online address book (extended) as key functionality: The main intention of members is to keep contact with people they know. The advantage of an SNP compared to a traditional address book must therefore lie in its capability to provide up-to-date contact information of its members.
- Advanced features should be made available for profile and contact management, and people search.

5 EMANICS involvement in Future Internet activities

In recent years, researchers in the networking area around the world have been investigating ways to solve the major problems that exist in the current Internet and designing a new Internet called the Future Internet, which has become a very hot topic, especially in the US, Europe, Japan and Korea. Network management is a very important area but it was an afterthought in the current Internet and thus managing the Internet is very cumbersome and difficult. As the researchers have just started architecting and designing the Future Internet, we also need to include the manageability from the beginning (i.e., in the design stage).

GENI and FIND in USA, FIRE, OneLab, AutoI in Europe, NWGN in Japan, and FIF in Korea are the some of the major research initiatives for developing the Future Internet. Similarly, the researchers around the world also have started working on the Manageability of the Future Internet. GENI OMIS WG in US, 4WARD in Europe, and CASFI in Korea are good examples of such research projects. We believe that this topic will be a very hot one in the network management community at least for the next few years.

In 2008, EMANICS carried out a variety of activities related to Future Internet and more specifically the management thereof. Table 7 gives an overview of most relevant events. We will then describe in greater detail information on two of the events. First, the presentation of results of the EMANICS workshop on “Vision and Management of the Future Internet” given by Gabi Dreo Rodosek at EuroView 2008. And second, the networking session organized at the ICT 2008 event.

5.1 EuroView2008 Presentation “The EMANICS Views on the Future Internet and Management Implications”

EMANICS has held a workshop on the “Vision and Management of the Future Internet” from July 3rd to July 4th in Bremen. Selected experts from within and outside EMANICS have been invited to discuss possible scenarios of the future Internet and the possible management implications. We came up with three possible scenarios to be discussed:

1. replacement of the current Internet with a “clean slate” design
2. many federated networks and generic inter-networking mechanisms
3. evolution happens around IP, while IP stays almost as it is

Does a “clean slate” design of the Internet means also a “clean slate” design of the management? Do we need to rethink existing management approaches and architectures? And if the evolution happens around IP, do we need to change anything wrt. to management concepts?

Although we have started to discuss scenarios and ist possible management implications, we came to the conclusion that it would be better to structure the discussion from a more layered perspective. Thus, the discussion was structured to discuss management challenges below, on and above IP.

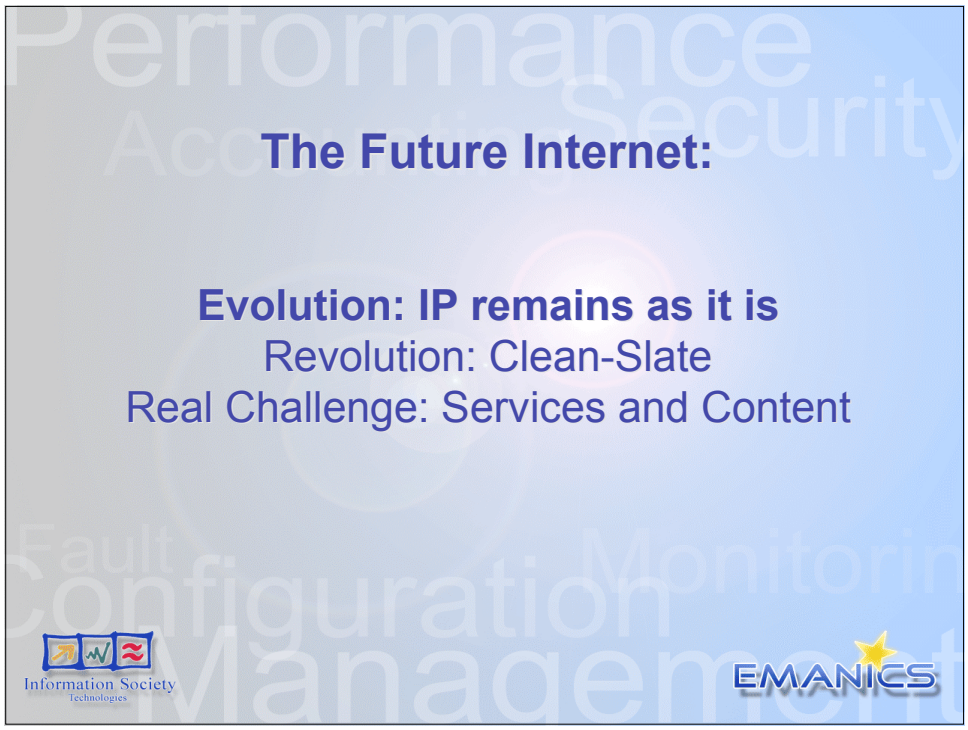
Here are some position statements from the group discussions:

Table 7: Future Internet activities 2008

Date	Location	Event	EMANICS involvement
January 2008	Dagstuhl	Perspectives Workshop: Telecommunication Economics	Organizer: Burkhard Stiller
May 2008	Barcelona	Joint ACF, AUTOI, EMANICS Workshop on Autonomic Management in the Future Internet	Organizer: Joan Serrat
July 2008	Bremen	EMANICS Workshop "Vision and Management of the Future Internet"	Organizer: Gabi Dreo Rodosek, Juergen Schoenwaelder, Iris Hochstatter
July 2008	Würzburg	EuroView 2008: The EMANICS Views on the Future Internet and Management Implications	Presenter Gabi Dreo Rodosek
September 2008	Vienna	Future Internet Symposium 2008: Management Challenges for Different Future Internet Approaches	Presenter: Iris Hochstatter
October 2008	-	IEEE Communication Magazine special issue on "Management of the Future Internet"	Editors: Aiko Pras, George Pavlou
November 2008	Lyon	ICT 2008 networking session "Management Challenges of the Future Internet" in	Organizer: Gabi Dreo Rodosek, Iris Hochstatter
December 2008	Madrid	Future Internet Assembly	Participants: Aiko Pras, Olivier Festor
January 2009	Dagstuhl	Seminar "Management of the Future Internet"	Organizer: Olivier Festor, Aiko Pras, Burkhard stiller
June 2009	Long Island	Workshop "Management of the Future Internet" in conjunction with the 11th IFIP/IEEE International Symposium on Integrated Network Management (IM'2009)	Organizer: Gabi Dreo Rodosek, Iris Hochstatter, James Hong

- The future Internet will have an all optical core, consisting of a few hundred optical switches, which provide end-to-end optical paths.
- Therefore we argue that the role of IP is dimishing; IP will become only an access technology.
- Future Internet = Content + Services.
- Since the users will perceive the future Internet in terms of contents and services, the user should no longer be bothered with details such as IP addresses, firewalls etc.
- The services of the future Internet are (amongst others): ubitiquous access to content and data, context-awareness, personalization of data and services, virtual and mixed reality games, services optimized for your mood, and new Human-Computer Interface.
- Access to a mass of sensor data sourronding the users lead to new services that we cannot image today.
- Security and privacy management will become increasingly important.
- We have to automate management to get the humans as far as possible out of the loop.
- The focus moves from network management, via service management to information and contents management.
- Although we believe that the core routing infrastructure of the Internet will be replaced by an all optical switched network (which can be considered as clean-slate design), the focus of research on the future Internet should be on services and the content (which will not need a clean-slate design).

The main outcomes of the workshop are summarized in the slides below.


The Future Internet:
Evolution: IP remains as it is
Revolution: Clean-Slate
Real Challenge: Services and Content
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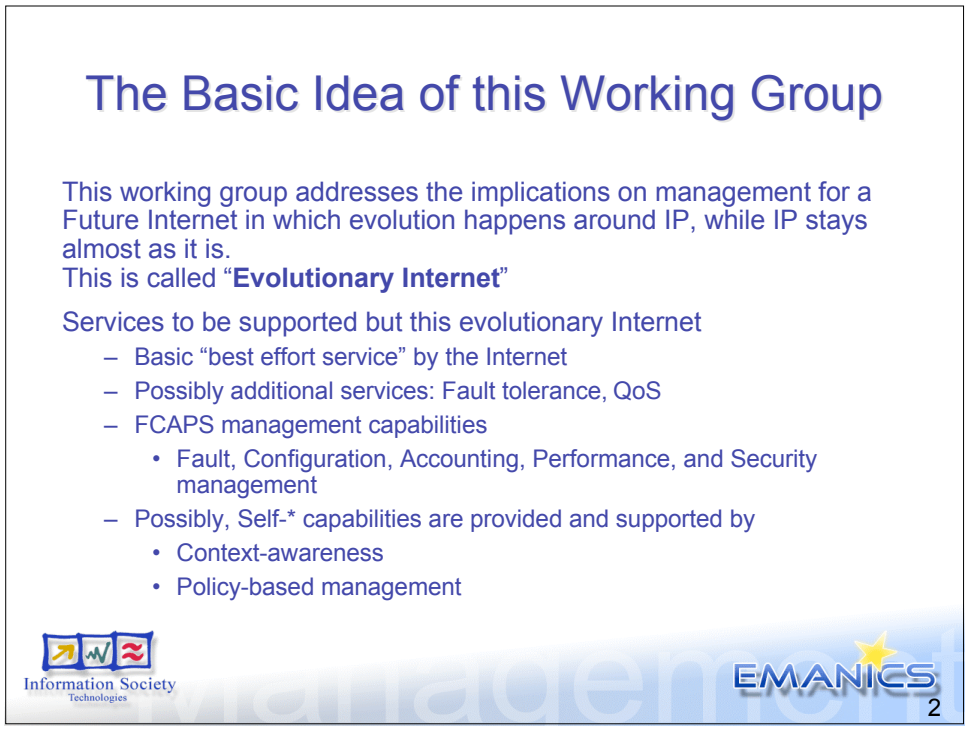
The Basic Idea of this Working Group
This working group addresses the implications on management for a Future Internet in which evolution happens around IP, while IP stays almost as it is.
This is called "Evolutionary Internet"
Services to be supported but this evolutionary Internet
– Basic "best effort service" by the Internet
– Possibly additional services: Fault tolerance, QoS
– FCAPS management capabilities
• Fault, Configuration, Accounting, Performance, and Security management
– Possibly, Self-* capabilities are provided and supported by
• Context-awareness
• Policy-based management
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2

Assumptions of the Evolutionary Internet

- Core network
  - There will be sufficient bandwidth available in the core network, assuming optical network technologies
  - The operator of the core network offers a simple data forwarding interface and does not want to expose management capabilities to its customers
- Access network
  - The bandwidth of the access network may vary, e.g. in the case of a wireless access network
  - Additional functionality is needed for a node to operate adequately in such an environment, e.g. with resource constraints, or changes in connectivity in a wireless environment

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3

Layering Requirements on Management

The Scenario implies requirements on relationship between layers

- There is management below the IP layer, e.g. managing a Metro-Ethernet, or managing wireless access networks
- There is management at the IP layer.
  This management must be aware of what happens below.
- There is management of functionality above the IP layer.
  This management must be aware of what happens below.

⇨ management of each layer should be aware of management of layer below

⇨ In some cases, management of one layer has to be aware of information of a layer above. Examples include:

- Information relevant for security, e.g. spam-related information (from application layer) is relevant for network layer
- Information of the type of service, e.g. youtube content, is relevant for management of the layer(s) below

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More requirements to the Management Plane

Which properties of the Internet in the Future must be considered?

- **Separate**, security-critical networks will exist (c.f. special sensor networks or vehicular networks) will be separate to the public internet, e.g. for nuclear power plant sensors are not exposed to the Internet.
  - These separate networks are managed separately.
  - Management functions must be fast (faster than a human being)
- Expected **growth** in number of devices.
  As capabilities of humans for managing the network are limited, the future Evolutionary Internet will feature
  - Relaxation of human intervention by automation and self-management
- Formation and release of dynamic and self-interested communities, and **decentralized** service provisioning
  - This scenario is related to the concept of composable services and implies growing complexity.
  - Individuals that want to offer services may not have knowledge or time to manage.
  - Interactions of millions of service providers must be possible.
  - The management should allow decentralization.
  - Logic is pushed into each device.
    Each device should ensure support of overall objectives
  - Management should allow delegation to the elements, i.e. the nodes should have autonomic capabilities.

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The Concept of Automated Management

Management features expected in the future Internet

- Automation: having static logic in an algorithm that specifies how to handle different situations. This is programmed by humans. The programmed logic fits to previously understood scenarios.
- Self-management: A device should be capable of configuring itself based on specific guidelines. End user and access network devices equipped with autonomic capabilities,
  i.e. with information sensing, decision making and enforcement.
  Decision making is based on programmability not restricted to the manufacturer of a device.

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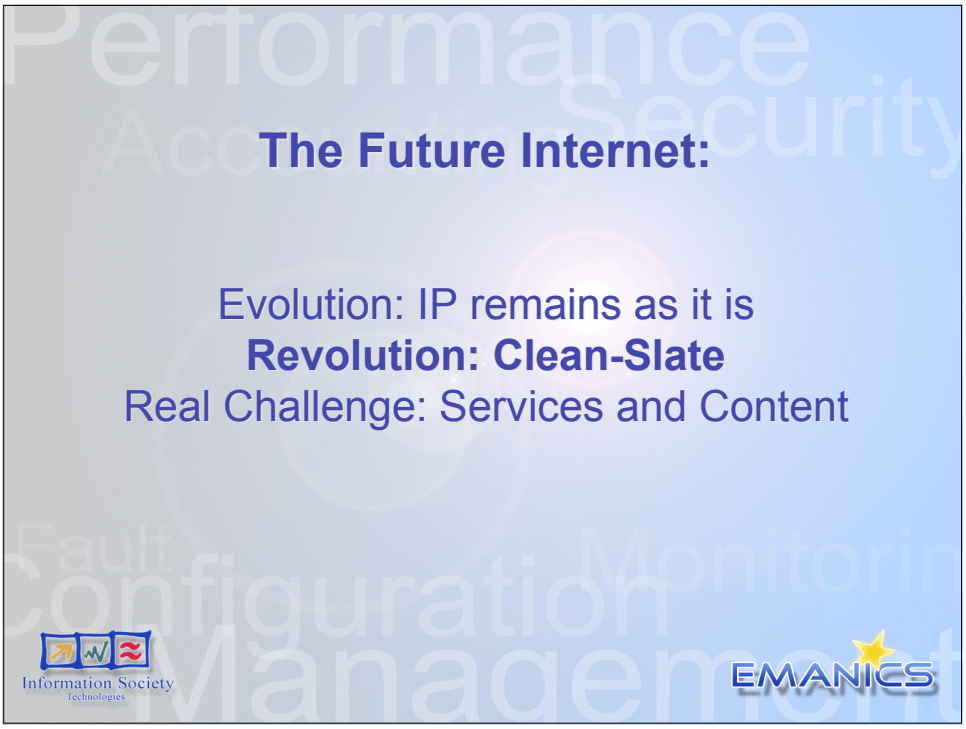
6


The Future Internet:
Evolution: IP remains as it is
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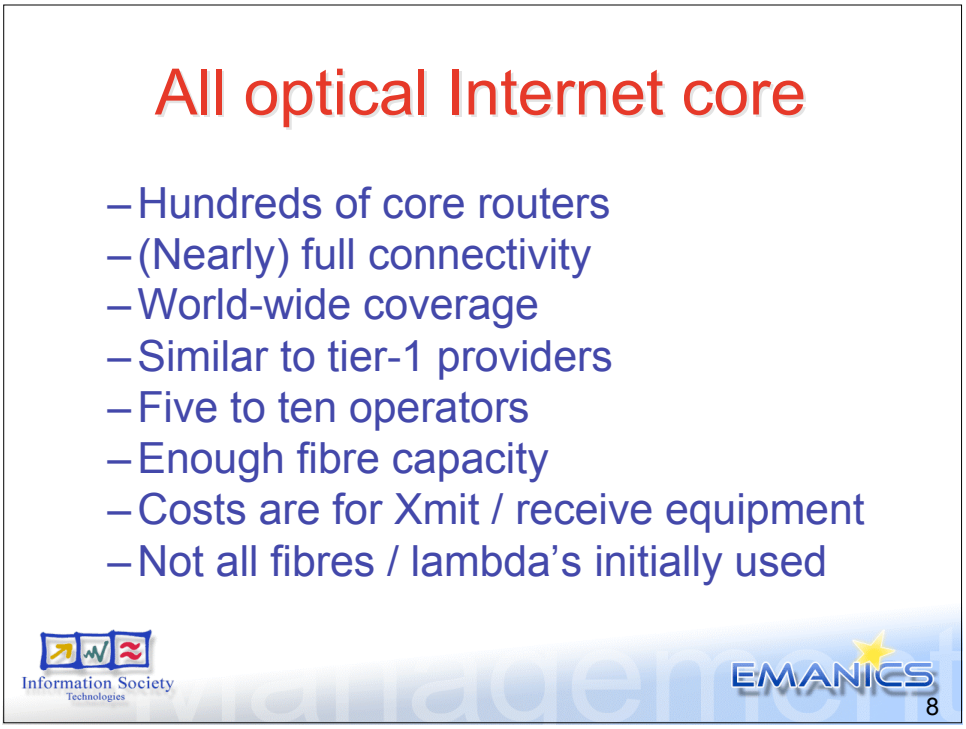
All optical Internet core
– Hundreds of core routers
– (Nearly) full connectivity
– World-wide coverage
– Similar to tier-1 providers
– Five to ten operators
– Enough fibre capacity
– Costs are for Xmit / receive equipment
– Not all fibres / lambda's initially used
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Configuration management

- Path planning / provisioning
- When to establish / release paths
- Inter-domain path request handling
- Resilience

(ensure you have different physical paths)

- Management technology is well known:

TL1, SNMP, GMPLS, ...

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Monitoring

- Needed for provisioning
- Needed for security (primarily DoS)
- What to monitor (not easy, with Tbps of data)
- Monitoring ports are needed

For lawful interception / data retention
Also at the intermediate optical switches
(each country on the path may have requirements)

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Access control

- Protect the core from the access and vice-versa
- Block sites
  - with unwanted content
  - which perform attacks
- Look like high-speed firewalls
- Current firewalls (rules) may not scale

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Outside the core

- Home networks
  - Will be managed by independent organizations
  - Open management interfaces are needed
- Fibre to the home
  - Subscription management
    VoIP, TV, Internet data, Google, Microsoft, ...
  - Dynamic / fast requests, on behalf of users

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Outside the core

- Wireless (broadband wireless, LTE, ...)
  - Manufacture gets control over the network
  - closed / homogeneous technology
  - Hard to do open research on
  - Handover between different access technologies
    WLAN / UMTS / ...
    VCC (Voice Call Connectivity)
    Charging is problem
  - Management of cognitive radio
    Detect failures, attacks
    Spectrum management

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The Future Internet:

Evolution: IP remains as it is
Revolution: Clean-Slate
Real Challenge: Services and Content

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7

Future Internet = Content + Services

Assumptions

- Ubiquitous connectivity
- Everybody will be able to create new services
- Some will change the way we work and live
- Networked sensors

Revenue models of the Future Internet

- Advertisement
- Selling content
- **Selling user information**

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Some Future Services

- Fully distributed storage with guarantees (archiving quality)
- Mesh-ups
- Health services
- Pregnant? Ask google!
- Complete life replay
- Locator services
- Social networking
- Context-aware services
- Personalization
- Services optimized for your abilities and disabilities
- Services optimized for your mood
- Virtual and mixed reality gamesCollaborative working

- **Ubiquitous access to sensor data leads to applications we cannot imagine nowadays**
- **New human-computer-interaction methods will impact networks**

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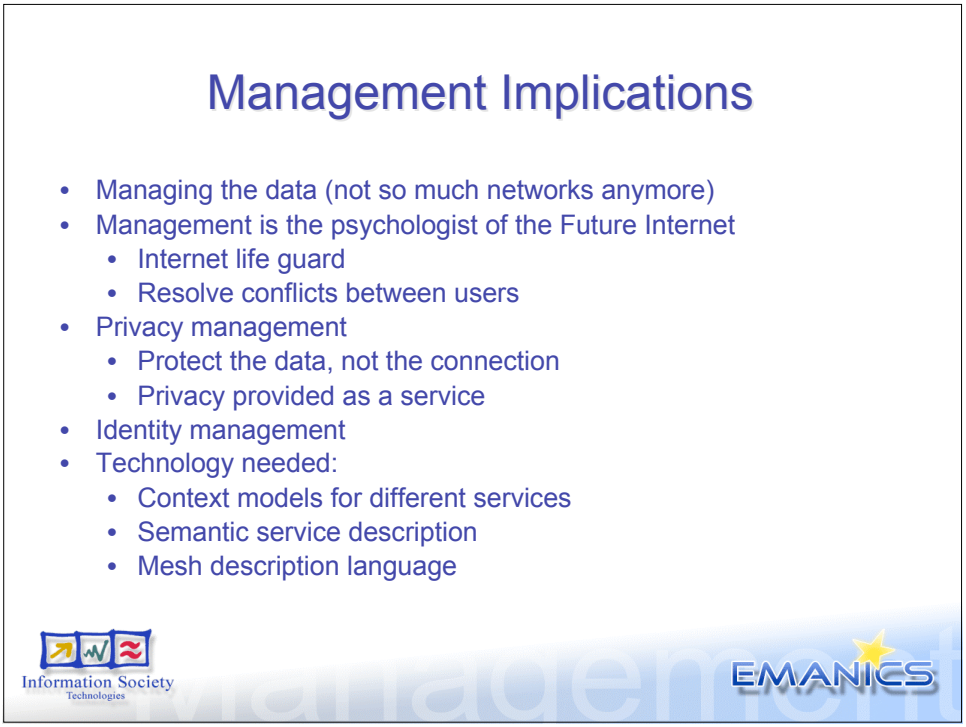
8


Management Implications
Managing the data (not so much networks anymore)
Management is the psychologist of the Future Internet
Internet life guard
Resolve conflicts between users
Privacy management
Protect the data, not the connection
Privacy provided as a service
Identity management
Technology needed:
Context models for different services
Semantic service description
Mesh description language
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5.2 ICT 2008 Networking Session “Management Challenges of the Future Internet”

Gabi Dreo Rodosek from the Universität der Bundeswehr München, Germany, and the FP6 NoE EMANICS hosted the networking session ”Management Challenges of the Future Internet” on November 27, 2008 from 11:00 until 12:30 in Lyon, France at the ICT 2008. The session was divided into two main parts: first, researchers from five projects presented the projects view on the Future Internet with a particular focus on its management. Second, Gabi Dreo Rodosek, member of the executive committee of EMANICS, moderated a panel discussion with questions from the audience. Details are provided in the agenda following.

Management Challenges of the Future Internet

Thursday 27/11/2008, 11:00 – 12:30, Room Saint Clair 3A

Dealing with the management challenges posed by the emerging Future Internet

The Seventh Framework Programme is funding a number of projects and initiatives addressing issues relating to the Future Internet, such as routing, architectures, protocols and service-driven changes. However, none of them explicitly address the management of the Future Internet which closely depends on its design. The question is whether we need a completely new approach to management or simply to enhance existing approaches. This session will bring together experts from different EU-funded projects dealing with the Future Internet to discuss the implications of their work on the management of the Web. The meeting will serve as a forum for exchanging viewpoints, as well as fostering and strengthening collaboration.

Coordinator: Gabi Dreo Rodosek

Agenda:

11:00 - 11:05 Welcome & Opening (Gabi Dreo Rodosek)

11:05 - 11:55 **Project presentations**: The project's approach towards management

EMANICS: European Network of Excellence for the Management of Internet Technologies and Complex Services (Aiko Pras)

SmoothIT: Simple Economic Management Approaches of Overlay Traffic in Heterogeneous Internet Topologies (Rafal Stankiewicz / Jan Derkacz)

AutoI: Autonomic Internet (Alex Galis)

4WARD: Architecture and design for the future Internet (Alberto Gonzalez)

Trilogy: Re-Architecting the Internet (Andrea Soppera)

11:55 - 12:30 **Discussion**: Research challenges & future collaboration (Chair: Gabi Dreo Rodosek)

Aiko Pras (UT) presented the EMANICS view, where he highlighted the co-existence of many different network (layers) and stated that in the near future there will be an all optical Internet core. With this development, four main challenges will arise: dependability, scalability, privacy/anonymity, and legal constraints. Jan Derkacz (AGH) illustrated the SmoothIT approach which focuses on economic traffic management and bases the management of overlay networks on a collaboration between the overlay provider and the network (underlay) provider in support of the user. For AutoI, Alex Galis (UCL) depicted the creation of a communication resource overlay with autonomic characteristics for the purpose of fast and guaranteed service delivery for the future. An autonomic management system will fulfill six main functions like e.g. aware and self-aware functions. Alberto Gonzalez Prieto (KTH) showed the 4WARD approach of in-network management for the Future Internet with two main goals: decentralisation and self-organisation. Last but not least, Andrea Soppera (BT - Network Research Centre) gave a description of Trilogy's concept to develop a unified control architecture for the Future Internet as well as develop and evaluate new technical solutions for key Internet control elements while assessing commercial and social control aspects.

Management Challenges of the Future Internet

Lyon, 27 November 2008

Aiko Pras
University of Twente
a.pras@utwente.nl

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What is EMANICS

- FP6 NoE
- Management of the Internet and Complex Services
- Started: 1-1-2006
- INRIA, University of Twente, Imperial College, Jacobs University Bremen, KTH Royal Institute of Technology, Oslo University College, Universitat Politecnica de Catalunya, University of Federal Armed Forces Munich, Poznan Supercomputing and Networking Center, University of Zürich, Ludwig-Maximilian University Munich, University of Pitesti, University College London, Caisse des Dépôts et Consignations

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2

EMANICS in the World

Leading research community worldwide:

- Run main conferences (like IM, NOMS, AIMS)
- Edit main Journals (ComMag, TNSM, JNSM, IJNM)
- Chair IRTF NMRG
- Chair IETF WGs
- Chair IFIP WG6.6
- Lead joint projects with main vendors and operators

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3

There is no single future Internet

- The network core
- The fixed access network
- The wireless access network
- The private network
- The overlay network
- The service network
  - Google's "are you pregnant" service

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4

Example: the future all optical Internet core

- Short term: Evolution (till 7 years)
- Long term: Revolution (after 7 years)
  - Hundreds of core routers
  - (Nearly) full connectivity
  - World-wide coverage
  - Similar to tier-1 providers
  - Five to ten operators
  - Enough fibre capacity
  - Costs are for Xmit / receive equipment
  - Not all fibres / lambda's initially used
  - Lambda switching

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EMANICS management

5

New management challenges

- ➡ Dependability
  - 99,999% availability
  - security threads
- ➡ Scalability
  - Core: Petabits / Home: Gigabits
  - from packet content, to header to flow analysis
- ➡ Privacy, anonymity
- ➡ Legal constraint

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EMANICS management

6

Non challenges

- QoS
  - Bandwidth not the problem
- Management middleware
  - CMIP, TMN, SNMP, CORBA, WBEM, WS, ...
- Self* / Autonomic management
  - Of course we must continue in this direction
  - But we already do that for decades
  - TCP, DHCP, Routing protocols, ...
- Management plane, knowledge plane
  - look at the first ISINM symposia

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7

THANK YOU

I assume there might be some discussion ;-)

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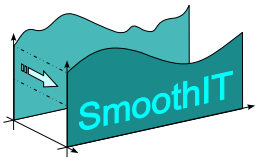
8

Simple Economic Management Approaches of Overlay Traffic in Heterogeneous Internet Topologies

European Seventh Framework STREP FP7-2007-ICT-216259



Economic Traffic Management (ETM): Scenarios and Architecture Design

UZH, DOCOMO, TUD, AUEB, PrimeTel, AGH, ICOM, UniWue, TID

Jan Derkacz, Piotr Chołda
AGH University of Science and Technology

ICT 2008
Lyon, France
27th November, 2008

 1

Outline

- Motivation and Examplary Scenarios
- Requirements and Expected Gains
- SmoothIT Architecture Design
- Management and Control Functionality
- Summary

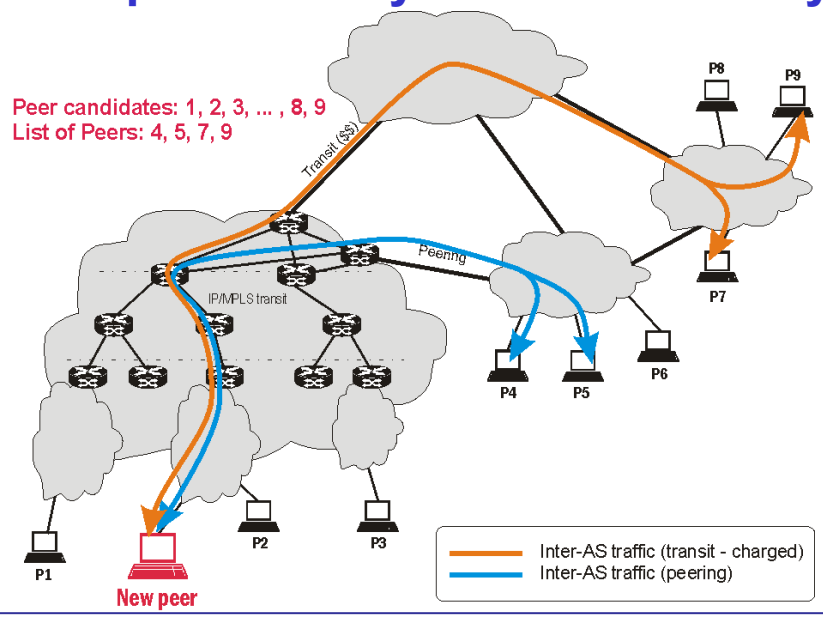
 2

Motivation

- P2P applications and traffic
  - Significant and increasing amount of P2P traffic
  - Suboptimal peer selection due to information asymmetry
    - Underlay *topology*, incl. *routing metrics and values*, unknown to overlay
    - Overlay *requirements,* incl. traffic characteristics, unknown to underlay
- Consequence
  - Non-optimized overlay traffic in the underlay
    - Higher costs in (a) underlay
    - Lower QoS in (b) overlay and for (c) application providers
  - Conventional traffic management techniques not suitable
- Goal of the SmoothIT project
  - Bridge overlay with underlay
  - Apply Economic Traffic Management (ETM)
  - Optimize traffic and achieve win-win-win situation for all parties

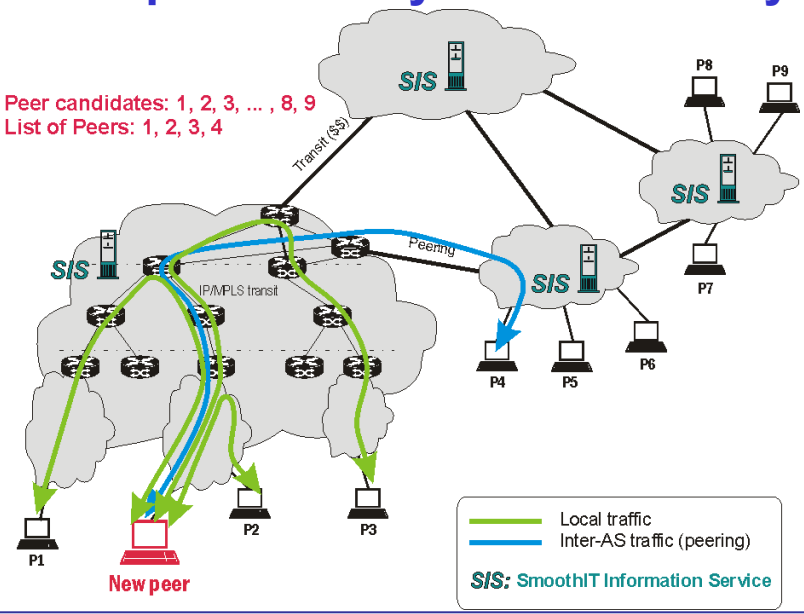
 3

Example: Locality-unaware Overlay



 4

Example: Locality-aware Overlay



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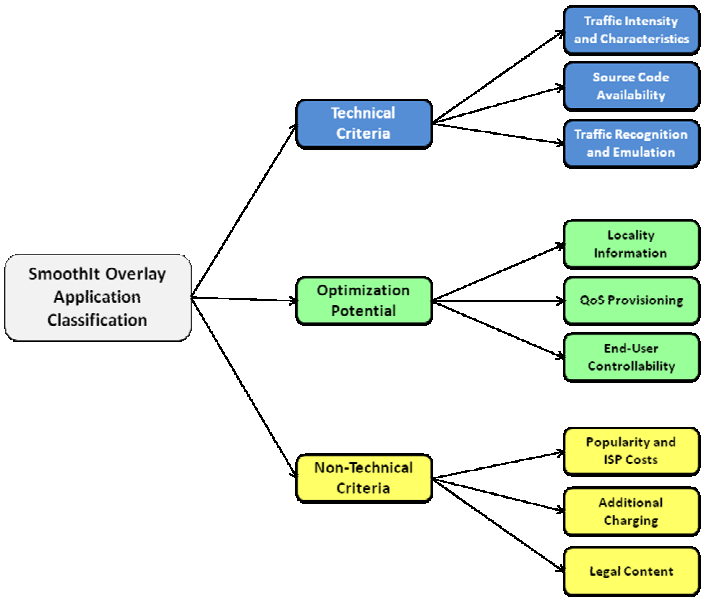
Classification Criteria



 6

Triple Win

- Management of **overlay networks** based on a collaboration between the overlay provider and the network (underlay) provider in support of the user
  - Cost and investment recovery for operators
- Incentives for operators
  - Monetary: reduce overlay traffic and inter-domain traffic
  - Traffic management: less congested links, better performance
  - Reputation: keep customers, distinguish from other operators
- Incentives for overlay providers
  - Performance: Active role in traffic mgmt increases service quality
  - Reputation: increased user base due to better performing services
- Incentives for user
  - Performance: Increased service quality, *e.g.*, reliability, RTT, BW
  - Monetary: lower price for network access

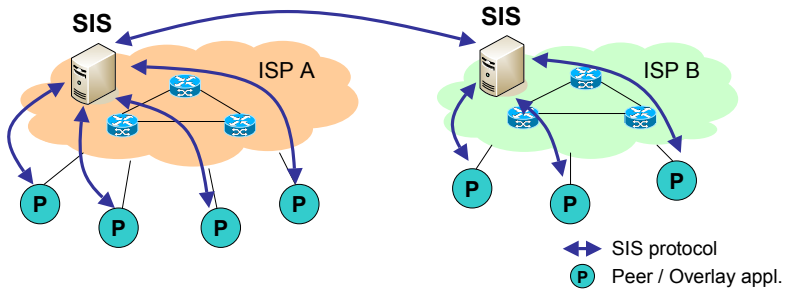
 7

Solution Concepts

- ISP-owned peer
  - Agreements between overlay provider and operator
    - *E.g.*, active caching: the ISP provides explicit local caches for content
  - No change in the overlay application
  - Overlay application dependent and legality issues
- ISP-managed information service
  - Locality promotion and QoS/QoE differentiation
    - Operator provides information about how to achieve best quality in overlay, *e.g.*, operator prioritizes alternative peer interconnections
    - Application-aware traffic management
  - Wide range of incentives
  - Requires changes in the overlay application
- Distributed ETM
  - Routers perform ETM autonomously
  - Scalability, robustness but may be more difficult to deploy

 8

SmoothIT Information Service (SIS)



- Deployment of SIS components in the ISPs' network
  - To convey information between overlay and underlay
- Client-Server architecture
- Overlay applications interact with SIS in order to select „better" peers
  - Reducing costs of ISPs
  - Improving QoE of users

Management functionalities

- Economic Traffic Management allows for the restructuring of overlay application topologies
  - Use of SOMs to influence overlay behavior to achieve ETM goals
- Traffic engineering according to the ISP policies and to the network status
  - SIS will provide an interface to the network administrator, where the preferences will be shown and configured in the ETM mechanisms
- SIS should be aware of the network status
  - Integration the OAM capabilities of the domain
- Dedicated management of overlay traffic is necessary
  - Due to smoothing large amounts of overlay traffic
  - Due to the minimization of high(er) costs for ISPs

Status and Summary

- Detailed requirements analysis undertaken
- SmoothIT architectural design in progress
  - SmoothIT Information Service (SIS)
    - Deployed in networks of ISPs
    - Provides information to overlay applications
    - Optimizes traffic and achieves the Triple Win situation
- SmoothIT participates in ALTO and covers socio-economic aspects of communications

 11

Thank you for your attention!

Thanks to all SmoothIT's project partners:

UZH, DOCOMO, TUD, AUEB, PrimeTel, AGH, ICOM, UniWue, TID

 12

Autonomic Internet (AutoI)

www.ist-autoi.eu

Alex Galis
University College London
a.galis@ee.ucl.ac.uk

27th November 2008
ICT2008 Lyon

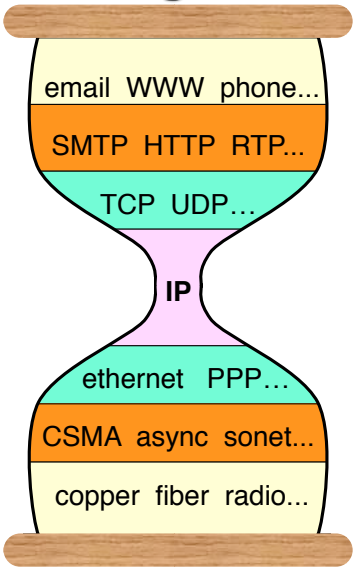
Contents

1. Autonomic Internet Project Presentation
2. Future Projects / Research Direction

Autonomic Internet Partners

- Hitachi - France (prime)
- Motorola USA
- UCOPIA – France
- Ginkgo Networks - France
- UPC - Spain
- University College London – UK
- INRIA – France
- University of Patras – Greece
- Lip6 – France
- TSSG – Ireland
- University of Passau - Germany

Notable Ossification : IP Hour-glass model



Service / Application Layer

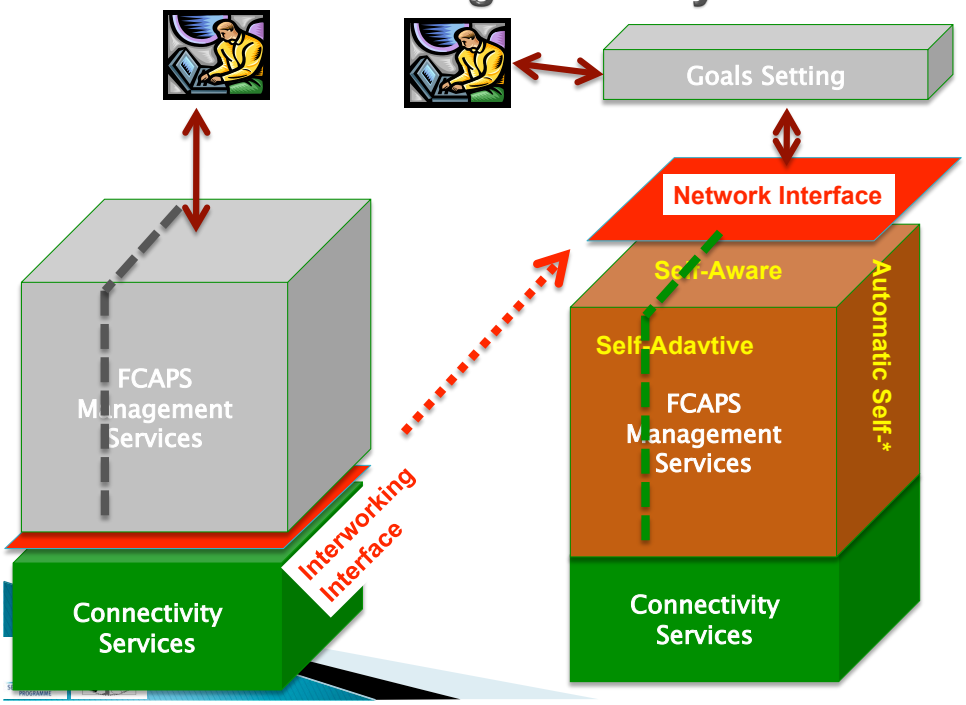
Network Layer

Link Layer

Project Concept & Objectives

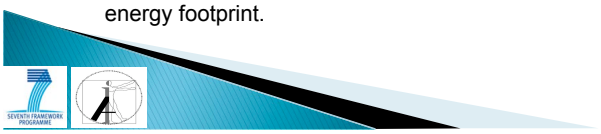
- Main Objective : Provision of a self-managing virtual resource overlay
  - The creation of a communication resource overlay with autonomic characteristics for the purposes of fast and guaranteed service delivery (“Autonomic Control Overlay”)

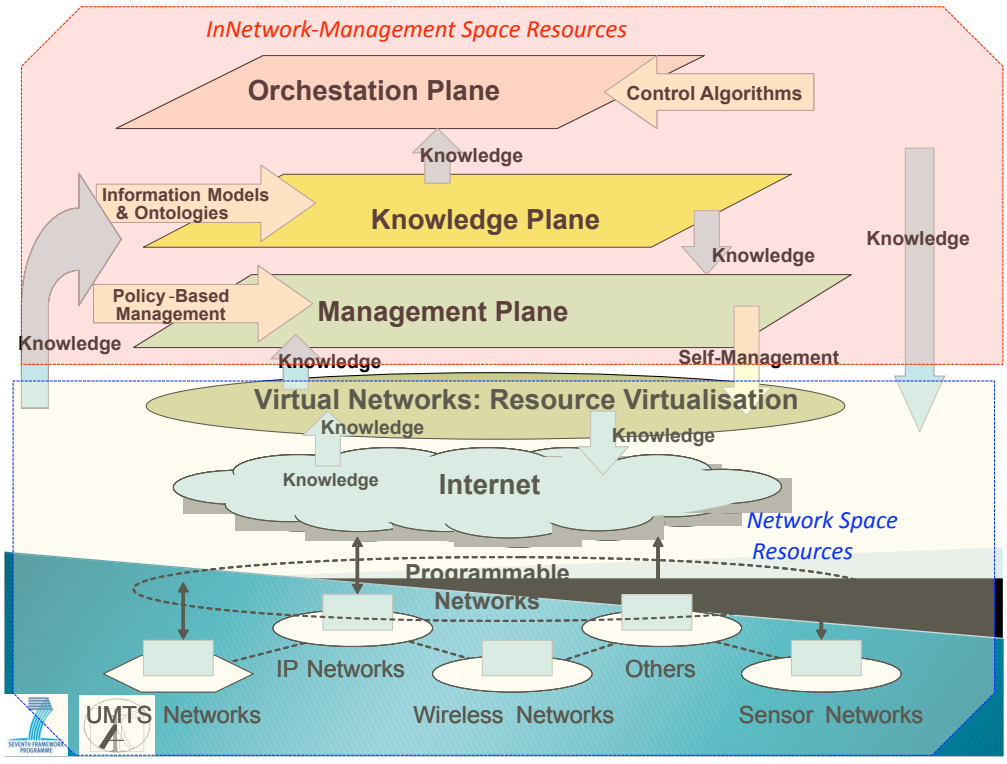
Autonomic Management Systems

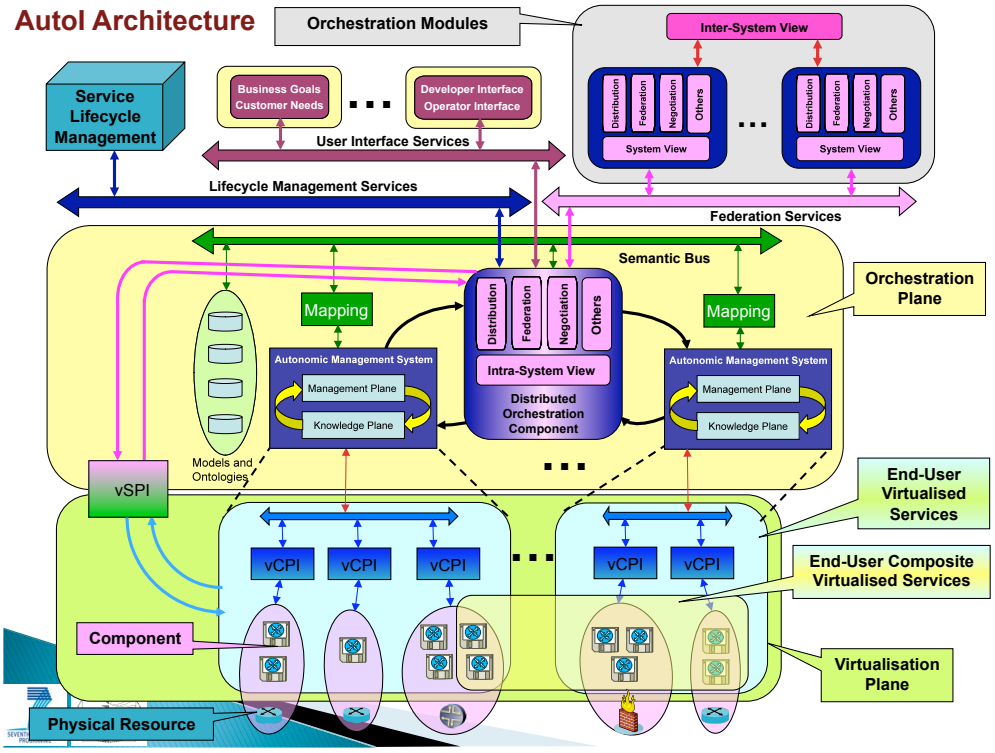


Autonomic management

- **Inside (In) Network functions:** The entire management functionality should be imbedded in the network.
- **Aware and Self-aware functions**: It monitors the network and operational context as well as internal operational network state in order to assess if the network current behaviour serve its service purposes.
- **Adaptive and Self-adaptive functions**: It triggers changes in network operations (state, configurations, functions) function of the changes in network context.
- **Automatic self-functions:** It enables self-control (i.e. self-FCAPS, -*) of its internal network operations, functions and state. It also bootstrap itself and it operates without manual external intervention. Only manual/external input is the setting-up of the goal(s).
- **Extensibility functions**: It adds new functions without disturbing the rest of the system (Plug_and_Play/Unplug_and_Play/ Dynamic programmability of management functions & services)
- **Simple functions**: Minimise life-cycle network operations' costs and minimise energy footprint.

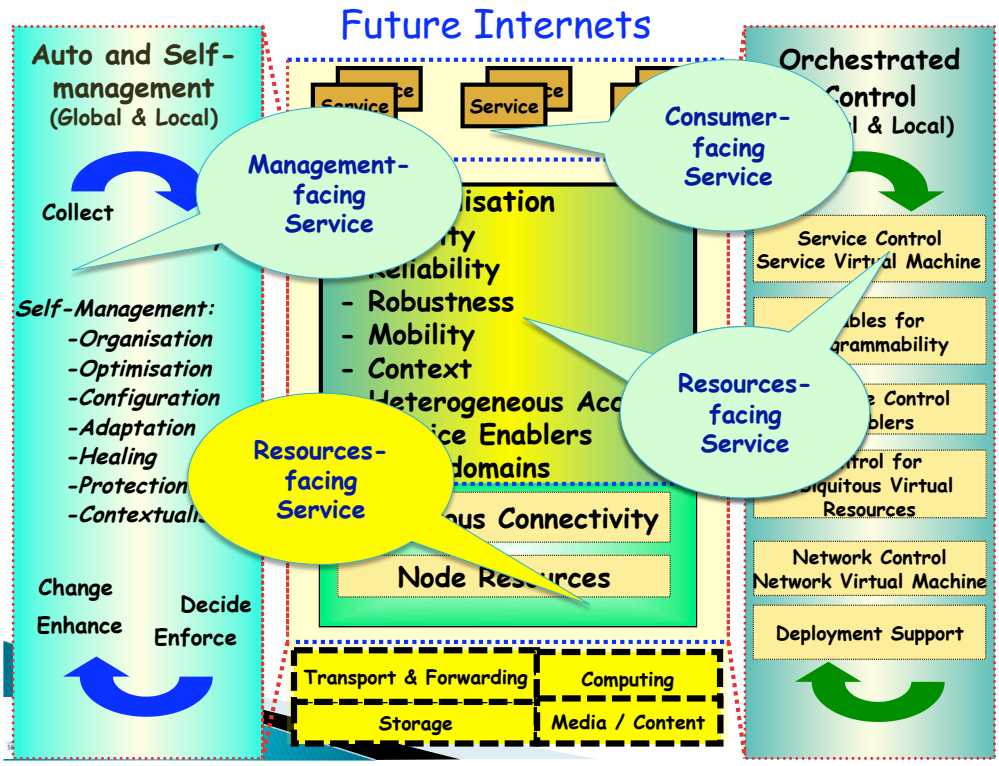






2. Future Projects / Research Direction

MANA (Management and Service-aware Architectures for Future Internets)



M&NA Research Direction (1)

ResearchTopics:

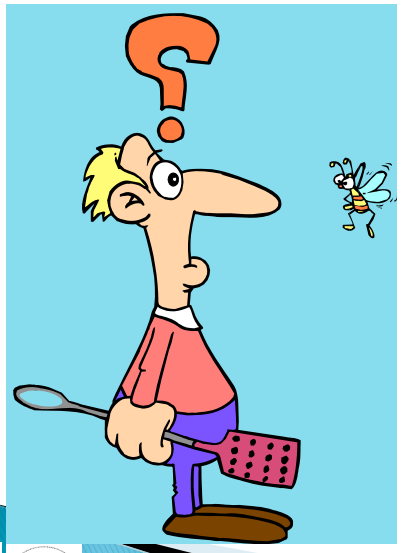
- **Define Ubiquitous Connectivity/Computation - infrastructures & architectures & resources & self-management and controls of such resources -**
- **Define Ubiquitous Virtual Resources & self-management of virtual resources-** integrated and flexible usage of heterogeneous and assumable virtual resources for networking, computation, storage, content, mobility, etc.
- **Define cross-domain Management functions** (i.e. networks, services, content) and cross-layers cooperative FI systems design for integrated management functionality, including: system lifecycle, self-X, SLA & QoS management,...
- **Imbedding management functionality in all FI systems** (i.e. InInfrastructures management, InNetworks management, InServices management, InContent management)

M&NA Research Direction (2)

Research Topics:

- **Dynamic deployment of (new)management functionality without interruption of FI systems' operation (**i.e. Pug-and-Play, UnPlug-and-Play, programmability**)**
- **Self-contextualisation for FI systems, services and resources**
- **FI Autonomicity and Self-awareness;**
- **Minimise life-cycle FI system costs & minimise energy footprint**
- **Orchestration and integration of management functionality**
- **Relationships between Self Management & Self Governance**

Thank you for your attention



Alex Galis
University College London
a.galis@ee.ucl.ac.uk

Perspectives on In-network Management for the Future Internet

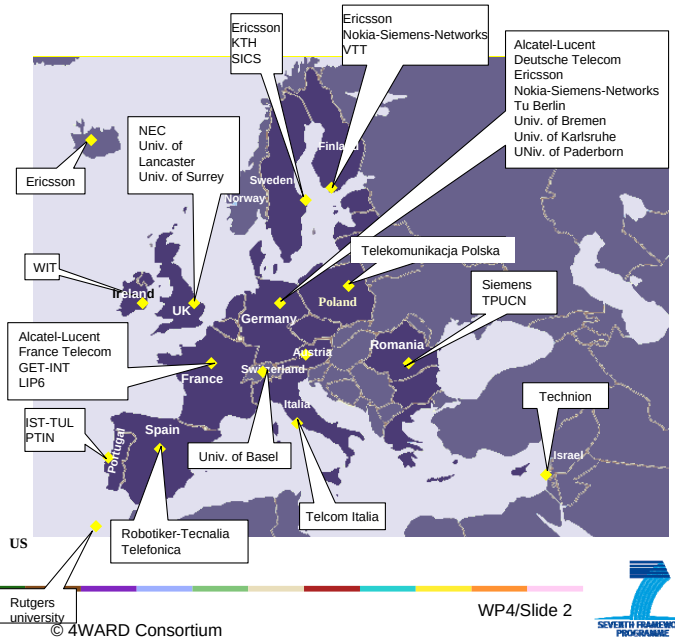
Alberto Gonzalez Prieto
KTH Royal Institute of Technology

(14 Partner Institutions)

November 27, 2008

The 4WARD Project

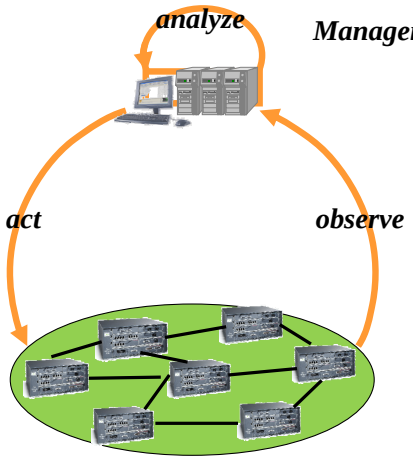
- Combination of **clean-slate approaches** to adress the Network of the Future
- 30 M€ ~ 45 MUS$
- Time 2 years



The 4WARD Project

- WP 1 Business Innovation, Regulation, and Dissemination
- WP 2 New Architecture Principles and Concepts
- WP 3 Network Virtualisation
- **WP 4 In Network Management**
- WP 5 Forwarding and Multiplexing for Generic Paths
- WP 6 Network of Information

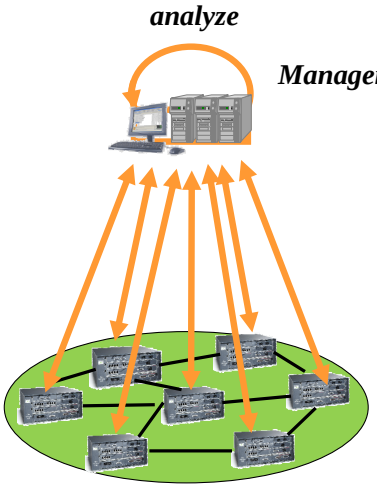
Today's Management Systems for Today's Internet



Management intelligence ***outside*** managed system.

Clear separation between management system and managed system, ***by design.***

Today's Management Systems for Today's Internet



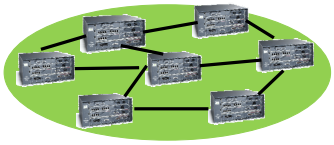
Configuration and monitoring, generally FCAPS functions, performed on a ***per-device basis***.

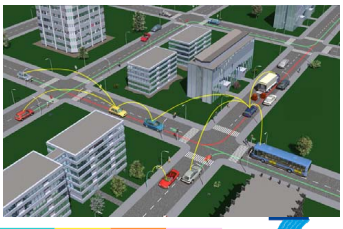
Successful for
- Small number of components
- Small rate of change.

In-network Management (INM): Automated Management inside the Managed System

Per element
- Capability detection
- Policy enforcement, conflict resolution
- Problem diagnosis and reporting

Per neighborhood, per domain, per network
- Aggregate state monitoring
- Threshold detection
- Anomaly detection

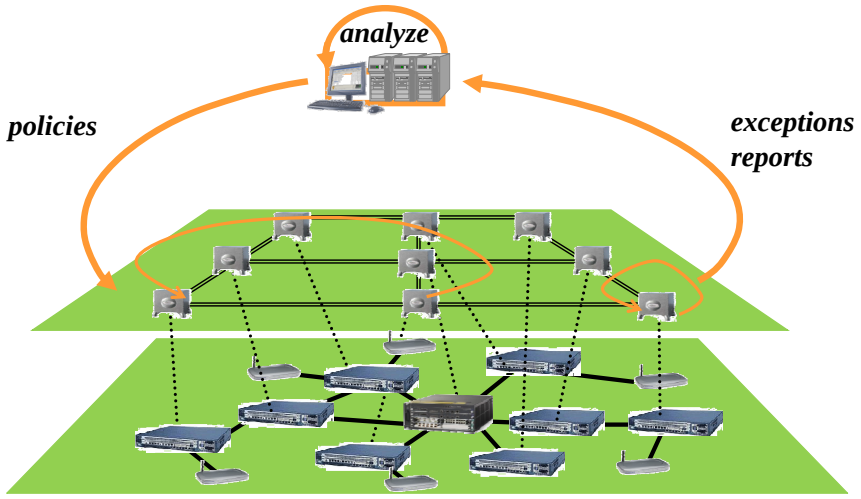




INM Goals

- Design management systems characterized by **scalability, robustness**, and **low complexity**
- Support large-scale networks that **dynamically adapt** to external events (self-configuration)
- Allow for **low-cost** operation
- The guiding principles to achieve these goals
  - **decentralisation**
  - **self-organisation**

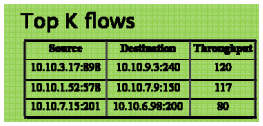
A Management Plane as part of the Network

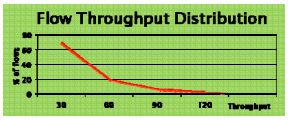


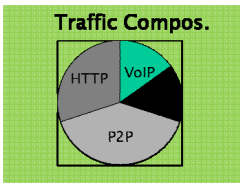
Some Challenges

- **Estimation of network states**, situation awareness, threshold detection….
- **Understanding and controlling trade-offs** between accuracy, overhead, execution time, robustness
- Builiding **tunable and self-tuning systems**

- Understanding the **semantics of mgt operations** on a large system under change

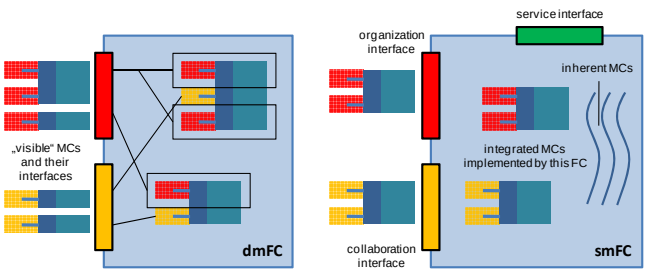






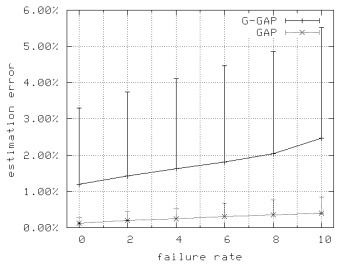
Framework for In-network Management

- Provide concepts for the in-network **management plane**
- Model the interaction between **embedded components**
- Design a **framework for in-network management.** Thin, pervasive management plane that **dynamically organizes**

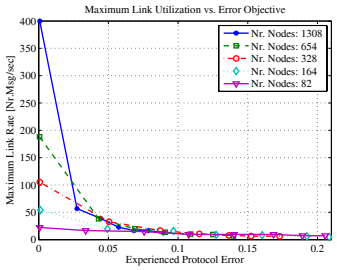


Algorithms for tunable Monitoring and Anomaly Detection

- **Monitoring algorithms** with controllable trade-offs: accuracy vs. overhead vs. timeliness vs. robustness
- Schemes for **collaborative identification and isolation** of threats or faulty components



Tree-based vs Gossip-based aggregation
Accuracy vs. failure rate

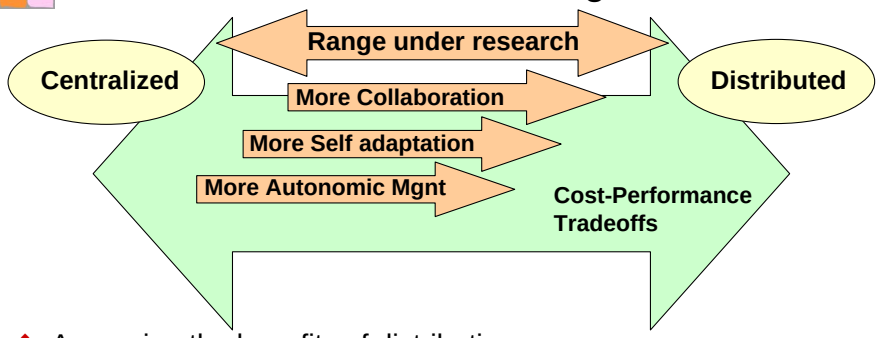


Distributed histogram computation
Accuracy vs. overhead

Algorithms for Self-Adaptation

- Schemes, strategies and protocols for collaborative **dynamic auto-configuration** and **self-healing**
- Algorithms for resource assignment, congestion control, ...
- Management of the management plane

Benchmarking of In-Network Management



- Assessing the benefits of distribution
  - Cost-performance tradeoffs, scenario dependent
- Self-adaptation time vs. protocol overhead
  - Protocol self-configuration, to meet monitoring performance objectives

1st Year Results

- Architectural framework for INM
  - Defines the structure of the management plane
    - Key concepts: management capabilities, functional components and self-managing entity
  - Different degrees of embedding, autonomy and abstraction
- Algorithms for real-time monitoring
  - Novel algorithms for situation awareness in large, dynamic environments
  - E.g., distributed histogram estimation over aggregation trees with precise evaluation of the overhead accuracy trade-off
- Applying INM to 4WARD architecture
- Business case for INM
  - Economic value of implementing INM in the future Internet

Trilogy
Re-Architecting the Internet

Management Challenges of the Future Internet

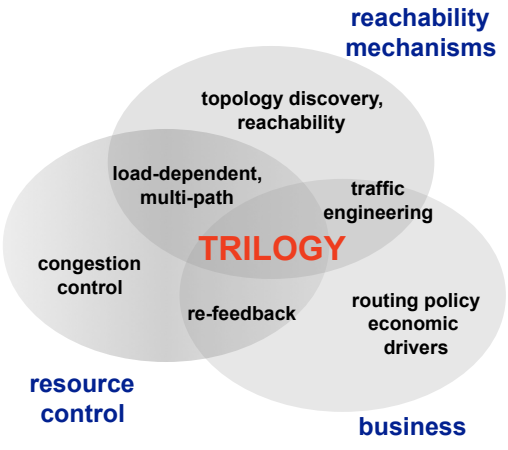
Andrea Soppera,
BT – Network Research Centre
November 2008

Trilogy – An Architecture for Change

Main Objectives

- Develop a **unified control architecture for the Future Internet** that can adapt in a scalable, dynamic and robust manner to local operational and business requirements
- Develop and evaluate **new technical solutions for key Internet control elements**: reachability & resource control
- Assess **commercial and social control aspects** of our architecture & technical solutions, including internal & external strategic evaluation

Trilogy Concept



Trilogy – Re-architecting the Internet 1 November 2008

Trilogy Design Principles

- Original Internet design principles

+

- Socio-economic goals

=

- Trilogy's 'tussle-aware' Design Principles
- (initial version)

Trilogy Design Principles

- Connectionless datagrams
- Packet switching
- IP at the waist of the hourglass
- End-to-end principle
- Etc

+

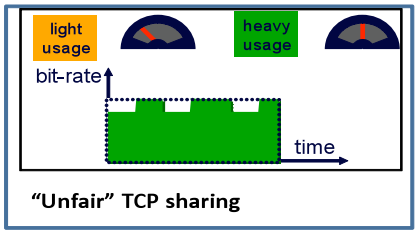
- Accountability (for usage of scarce resources)
- Efficiency (maximise utility)
- Sustainability (resilience, scalability)
- Diversity (of businesses, networks, apps, users…)

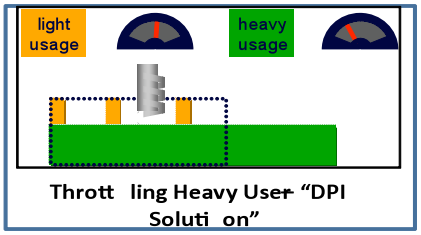
=

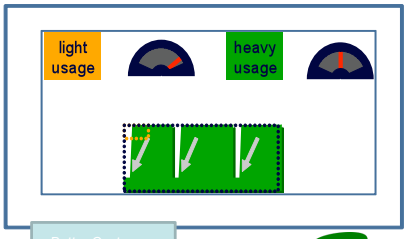
- Information exposure
  - Data (or transaction) integrates info about its resource usage
- Separate policy and mechanism
  - Allow local choice but interact through common mechanism
- Fuzzy ends
  - Allow end point to explicitly delegate some functions into the network
- Resource pooling
  - Allow network's resources to behave like a single resource

Scenario: Managing P2P Traffic

Those who take most, get most.
Can we afford to have an Internet without resource control?





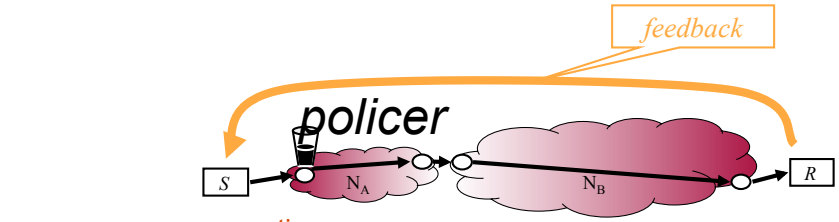


Allow faster light usage.

Better Customer Experience

trilogy

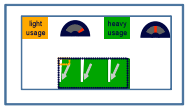
Re Feedback basics – Accountability



congestion

Today's ECN

Re Feedback

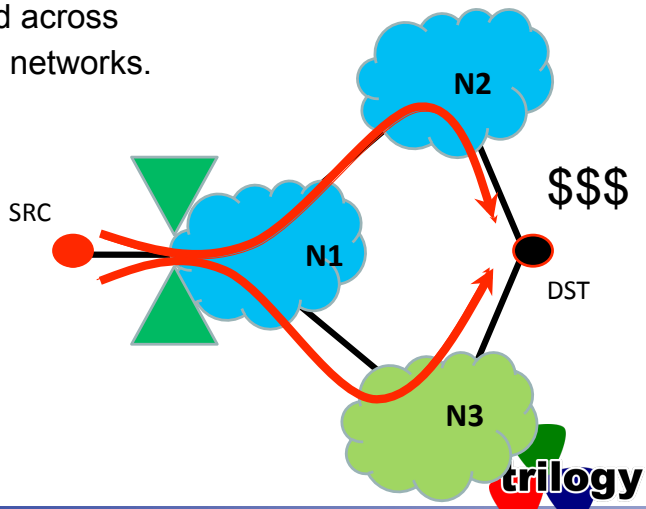


trilogy

Multi-Path Transport – Resource Pooling

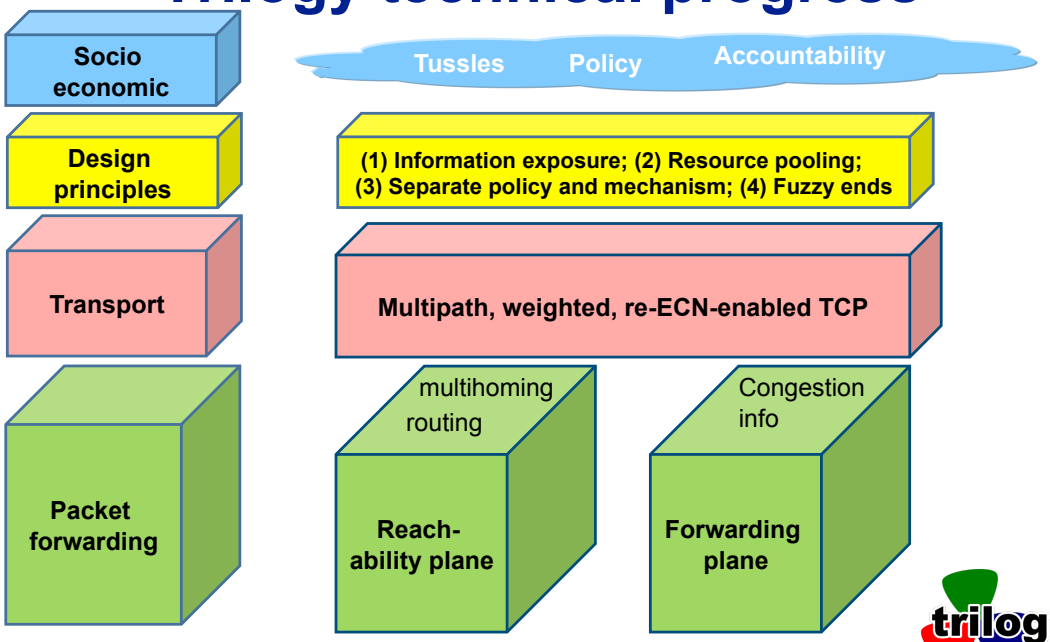
- Make a network's behave like a single pool of resources
  - Aim is to increase reliability and efficiency
  - Method is to shift load across the various part of the networks.

➢ Source best place to choose the best path for transmission (e.g. low cost path) and manage mobility and multi-homing.



Trilogy – Re-architecting the Internet 6 November 2008

Trilogy technical progress



Trilogy – Re-architecting the Internet 7 November 2008

Challenges Ahead

- Simplifies networks and Enable new Services
- Gives the end user control but policed by the network
- User controlled fine grain QoS
- Trust and protection against cheating
- Fundamental change from TCP - being debated/ standardised in the IETF

After the project presentations, a panel with all speakers plus Miguel Ponce de Leon (4WARD and Waterford Institute of Technology) discussed research challenges of the Future Internet from the management perspective. All panelists agree that

1. Management of the Future Internet is an important research topic that needs to be addressed
2. Management has to be approached at the design phase of the Future Internet, not afterwards
3. Management needs to be a part of the Future Internet (built-in), not separate

More information including the presentations is available at:

http://emanics.org/content/view/148/36/

Comments from the community:

- Olivier FESTOR (INRIA, France)
  Management is crucial for the success of the future Internet. There fore a session dedicated to it is really useful since the topic is covered across many projects today without sufficient coordination.
- Aiko PRAS (University of Twente, Netherlands)
  There is general agreement that management of the future Internet should not be added as an ”afterthought”, but considered from the very beginning. So lets discuss this now!
- Christian ESTEVE ROTHENBERG (University of Campinas, Brazil)
  Key topic in any future Internet proposal!
- Burkhard STILLER (University of Zurich, Switzerland)
  Network management is important for the reliable and safe operation of networks, thus, a view into future management issues and tasks for the future Internet has to be discussed now.
- Gabi DREO RODOSEK (Universitt der Bundeswehr Mnchen, Germany)
  As discussed with the colleagues at EuroView 2008 (workshop series that focuses on ”Visions of Future Generation Networks”), it is essential to address management issues of the future Internet right from the beginning. A key argument for that is that management of the future Internet will be in-band, nothing separate.
- Juergen SCHOENWAELDER (Jacobs University Bremen, Germany)
  I have attended several workshops related to the Future Internet and it is clear that management aspects will play a much bigger role in a Future Internet in order to provide a dependable and at the same time cost efficient network reaching out to billions of embedded devices.
- Alex GALIS (University College London, United Kingdom)
  Management and Governance is the central topic of research in Future Internet of Networks and Services. As such I support this networking session.

- Miguel PONCE DE LEON (Waterford Institute of Technology, Ireland)
  In supporting this networking session I hope we can discuss the possible embedding of management capabilities in future internet architectures and protocols,

- Joan SERRAT (UPC)
  Management of services and network infrastructure constitute part of the key challenges in the conception of the Future Internet.

- Prosper CHEMOUIL (France Telecom, France)
  I support this networking session as Future Internet calls for automated procedures of management and operations. This creates a real challenge both in theoretical and operational aspects.

- James HONG (POSTECH, Korea, Republic Of)
  This session is very important and timely as it can bring together researchers and developers working on the management of Future Internet not only from Europe but also from other parts of the world such as Korea, Japan and US, where the research on Future Internet is very active.

- Pablo AROZARENA (Telefnica I+D, Spain)
  Taking into account management aspects rigth from the start could make the evolution towards a Future Internet easier. Therefore, I think this session is highly relevant to the research community.

- Spiros SPIROU (Intracom Telecom, Greece)
  Users and offered services are bound to increase on the Future Internet. If these should work smoothly, some form of underlying management should be discussed sooner rather that later.

- Alexander CLEMM (Cisco, United States)
  If there is anything the past should have taught us, it is that management should not be an afterthought in the design of a system or a network. In particular in discussions of a ”Future” Internet, management aspects must be considered from the onset of requirements identification and design. Hence, I strongly support this session.

- Alexander KELLER (IBM Corporation, United States)
  Management keeps today’s and the Future Internet running effectively and efficiently. This session is very much needed in order to establish a common understanding on what management paradigms the Future Internet will require.

- Danny RAZ (Technion, Israel)
  Having Network Management an Integrated part of the full technical architecture, and even more important, of the global vision of the Future Internet is really the most important single factor in the ability to make it efficient and accessible for all. Having the proposed session (or similar meetings) is a key ingredient toward this goal as it is a very efficient way to incorporate the vast amount of knowledge existing in the NM research NM community into the Future Internet vision.

- Heinz-Gerd HEGERING (Leibniz Supercomputing Center and University of Munich)
  Networked applications and services are mission-critical in a business and educational environment that is driven by the various aspects of globalisation. The requirements for running such services and the necessary netwaorked IT systems in a reliable, safe, and cost-efficient mannor are becoming more and more complex: they can only be met on the basis of thoroughly researching the challenging topics of IT governance and management.

- Michael MENTH (University of Wuerzburg, Germany, Germany)
  Drivers for the Future Internet are increased reliability, enhanced services, more flexibility, and simplified operation. The latter calls for including network management issues into the design process for Future Internet principles. It's good to learn about such ideas in a session dedicated to that topic.

- Bert WIJNEN (Independent, Netherlands)
  Network Management has often (always?) been an afterthought. It is very important to think about it and design it into any future network architecture. So a session about this topic is most appropriate.

- Dan ROMASCANU (AVAYA, Israel)
  I find that such a session would be very useful. Taking into account the needs and requirements of the operators and designing the future networks for manageability and usability is key in any discussions and architecture planning of the evolution of the Internet.

- Benno OVEREINDER (NLnet Labs, Netherlands)
  A session on network management is very useful. Certainly for a Future Internet, network management should be an integral part of the infrastructure. Management is a key factor in manageability, usability, performance, etc., and is an important factor to the operational costs of a network.

- J.P. MARTIN-FLATIN (NetExpert, Switzerland)
  There is a dire need in industry for efficient network management solutions. The management of the current Internet poses problems because it was an afterthought. This session should help define management requirements that will influence the design of the Future Internet and facilitate its management.

- Adrian PASCHKE (Free University Berlin, Germany)
  Right, an Internet of Services with complex services embedded in distributed Web-based business processes needs new ways of managing, such as Event-driven BPM (EDBPM) and enabling technologies such as Complex Event Processing to detect and predict in real-time relevant management decision situations from a huge event cloud.

- Young-Tak KIM (Yeungnam University, Korea, Republic Of)
  Efficient and optimized network resource managements for QoS-aware/guaranteed triple play service (VoIP, IPTV, Data) provisioning are strongly required in next generation Internet. This session for management challenges for the future Internet is strongly needed to provide good discussions and exchange of ideas for successful & economic future Internet.

- Saviour BALDACCHINO (ICT Systems Engineering, Malta)
  This session will be very useful and it should emphasize the need for in-built management layers as an integral part of every future service under the Internet umbrella.

- Bob NATALE (MITRE, United States)
  Sorry to be so late with a comment. I support all of the foregoing comments (but do have a question about the ”in-band” only suggestion...not sure about that). I would like to add the management approaches for the Future Internet should build in proactive network defense operations – not leave it entirely to post facto security management functions. Maybe we need a new moniker – perhaps ”network assurance” – to ensure this crucial work gets its due attention...?

- Martin SERRANO (WIT - Waterford Institute of Technology, Ireland)
  Future Internet requires a new management approach, promoted mainly by the necessity of support interoperability between heterogeneous, complex and distributed systems. The cooperation and the governance between the systems and the communities respectively plays and important role in this new approach. Transition or evolution in Internet? It is unclear but the scope and directions of the Future Internet management must be clear and well oriented to avoid the agnostic management and/or provides unrealistic solutions.

- Kurt LINDEROOS (Personal EU United Brains Oy Ltd., Finland)
  Persons are the base unit of living - and their challenges are the challenge of mgmt of the future internet. On EU level a ”Personal EU” era vision and process offers an inspiring challenge. Please see
  http://www.personaleu.eu/Your_role_and_challenge/Idea/idea.html and my proposal to the ENoLL 3rd wave,
  http://www.personaleu.eu/Personal_EU/ENoLL_Application/enoll_application.html

- Karthik KUMAR S (Interactive Technology Software and Media Association (ITSMA), India)
  Very interesting and would like to attend this session. Euro-India Research Centre (EIRC) being the key entity of the Indian National Contact Point (NCP) looks at concrete, practical areas for collaboration. So I would like to invite the like minded to participate in our networking session called “Euro-India ICT Cooperation Gateway” (http://ec.europa.eu/information_society/events/cf/item-display.cfm?id=823) for fostering this opportunity. You can also visit us at www.euroindiaresearch.org or mail me at karthik@euroindiaresearch.org / karthik@itsmaindia.org

6 Report on Integration, Collaboration and the Visibility of EMANICS

This section combines the reports from different activities related to the measurement of integration within EMANICS, the taxonomy for terms in network and service management, and the visibility of EMANICS and the whole community through publications.

6.1 EMANICS Integration Graphs

One main objective of the EMANICS Network of Excellence is to improve cooperation and integration of European research institutions in the field of network and service management. One dimension for cooperation in the scientific world is the number of published joint papers. In order to work out this number we had to find adequate sources which could be tapped.

6.1.1 Implementation

There are several well known bibliographic systems like IEEEXplore[1], CiteSeer[2], DBLP[3]. But not all of them provide the opportunity to download or access the available information directly. The DBLP Computer Science Bibliography from the Universität Trier [1] lists more than 2^{20} publications and is – as far as we know – the only bibliographic system for computer science papers which provides a data exchange opportunity, it offers an XML-based interface. For using DBLP data, we have implemented a tool for importing XML data in a MySQL database. This tool automatically grabs the XML file offered by the DBLP webpage and writes the data in four separate tables in our database: `collection`, `author`, `cite` and `crossref`. The table `collection` holds all relevant information like `title`, `type`, `year` etc. The tables `author`, `cite` and `crossref` store additional information with a reference to the collection table by means of the primary key called `collection_key`.

The tool uses a configuration file with makes it adaptable to other sources and in addition, it is applicable in an automatic way.

6.1.2 Evaluation

After the data mining process, we had to conjoin the EMIN database with the DBLP information concerning the EMANICS team members. The problem we had to solve here was that the only available key was the team member name and institute. After the successful marking of all EMANICS team members in the DBLP imported database, we could determine the number of joint papers of the EMANICS group members.

Figure 11 shows the number of papers which are written by at least two EMANICS partners and have been published in the time period of 1997 until 2007. For the actual year the

[1] http://ieeexplore.ieee.org
[2] http://citeseer.ist.psu.edu/
[3] http://www.informatik.uni-trier.de/ ley/db/

data of only some published papers is available in the DBLP database. Because of this fact, the number of published papers for the year 2008 is only estimated.

Regarding the years before the EMANICS project started (before 2006), the peek in the year of 2003 is obvious. But when we compare the numbers of 2003 with 2004 to account than the number of joint papers is nearly constant, lightly increasing in the course of time. In the time of the EMANICS project beginning in the year 2006, the number of joint papers nearly equals to the previous level at first. In the second EMANICS year (2007) the number of joint papers was nearly doubled with respect to the year 2006. For the year 2008, we estimate that the high level will continue.

As Figure 11 shows, the EMANICS project has enhanced the cooperation between the project members.

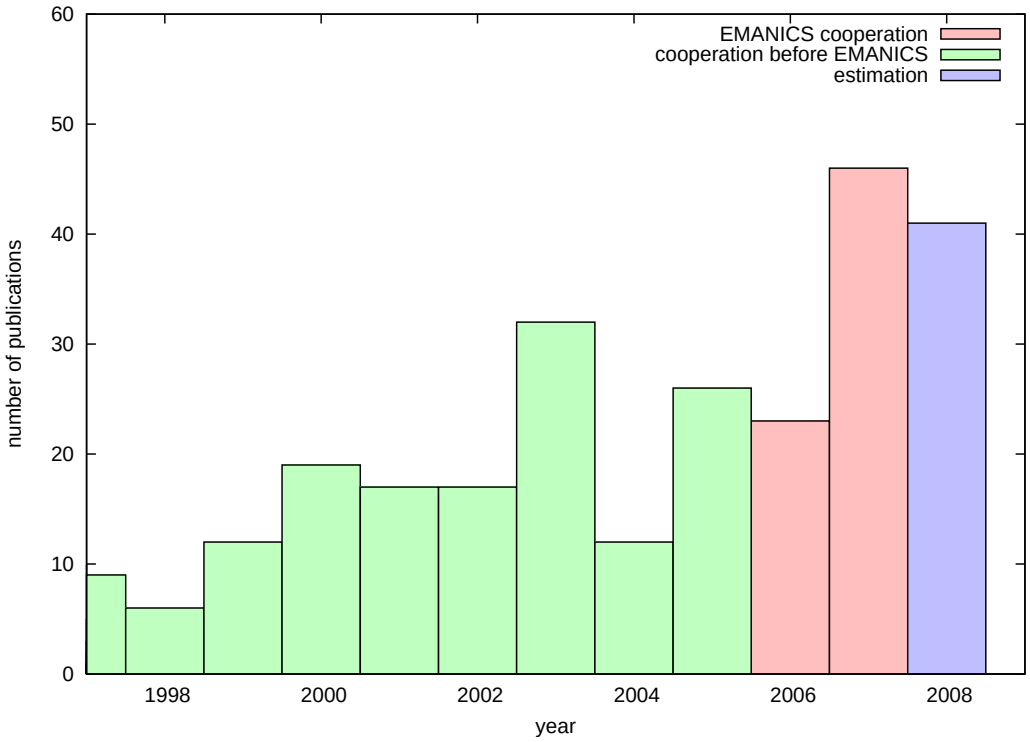


Figure 11: Joint published papers based on DBLP data

6.1.3 Integration of other data sources

The evaluation of the DBLP information gives us the opportunity to conjoin the DBLP data also with other available data sources. Other available data sources are the JEMS conference system [2] and the database of the EMIN tool. The EMIN tool was developed to measure the integration of the EMANICS partners in the previous phase and updated continuously. Based on this data, the JEMS conference system information and the information from the DBLP bibliography system, we have build a web-based application. This application allows the user to get information about the actual level of integration of the EMANICS partners.

Figure 12 shows a snapshot of the application home page. The application webpage is separated into two parts. In the upper part a list of all partners is shown with information about the work packages they participate in. Additionally, the user can request information about the partner members of the institutes and the research topics of the EMANICS partners.

In the lower part of the application webpage the user is informed about the common activities of the EMANICS partners depicted in a timeline. Based on the available data from DBLP, JEMS and EMIN the timeline shows the following activities ordered by time:

- conferences
- papers
- mobility

The item conferences shows all TPC conference activities of EMANICS members based on the JEMS database. Information about scientific papers written by EMANICS partners are shown at the point papers. The DBLP database is taken as a basis for this information. The point mobility is shown by means of EMIN data. The application shows when events such as the general assembly, work package meetings, and scientific visits took place.

6.1.4 Worldwide Research Map

The idea of a research map is to show people the cooperation of the partners and the research topics geographically. In order to show the cooperation level of EMANICS partners and to give them the opportunity to search for partners for a given topic, an EMANICS research map tool was build. As reported in deliverable D1.4 [3], we have used the JEMS database with a Google Maps [4] frontend for a worldwide research map. Here we reused this Google Maps code and extended the frontend with the opportunities of showing the possible partners and a tag cloud with co-topics.

As depicted in Figure 13, the EMANICS research map website is trisected. The upper part contains the input text field where the user can enter research topics. If this is done, all to this context related other research topics are presented in a tag cloud in the undermost part of the application GUI. The user can extend the listed topics in the upper part by simply clicking on the topic name in the tag cloud. This implicates a new computation of the tag cloud and the middle part of the application GUI. In this middle part - the main part - the mentioned Google Map and a list of researchers is shown whose research interests are relevant to the given topics. The Google Maps window shows the geographical position of the institute where the listed researcher works. So the user gets an impression of the geographical spreading of the topic at a glace. Furthermore, the map shows in which countries the topic's main focus lies.

In a situation where a user may use the tool for searching cooperation partners for a given topic of interest, the application gives the user a list of candidates plus a geographical overview of those institutes' locations. Additionally, we have integrated the LinkedIn information add-on which enables the user to get supplementary information and the possibility to start a communication with the partner to-be by clicking on the LinkedIn button

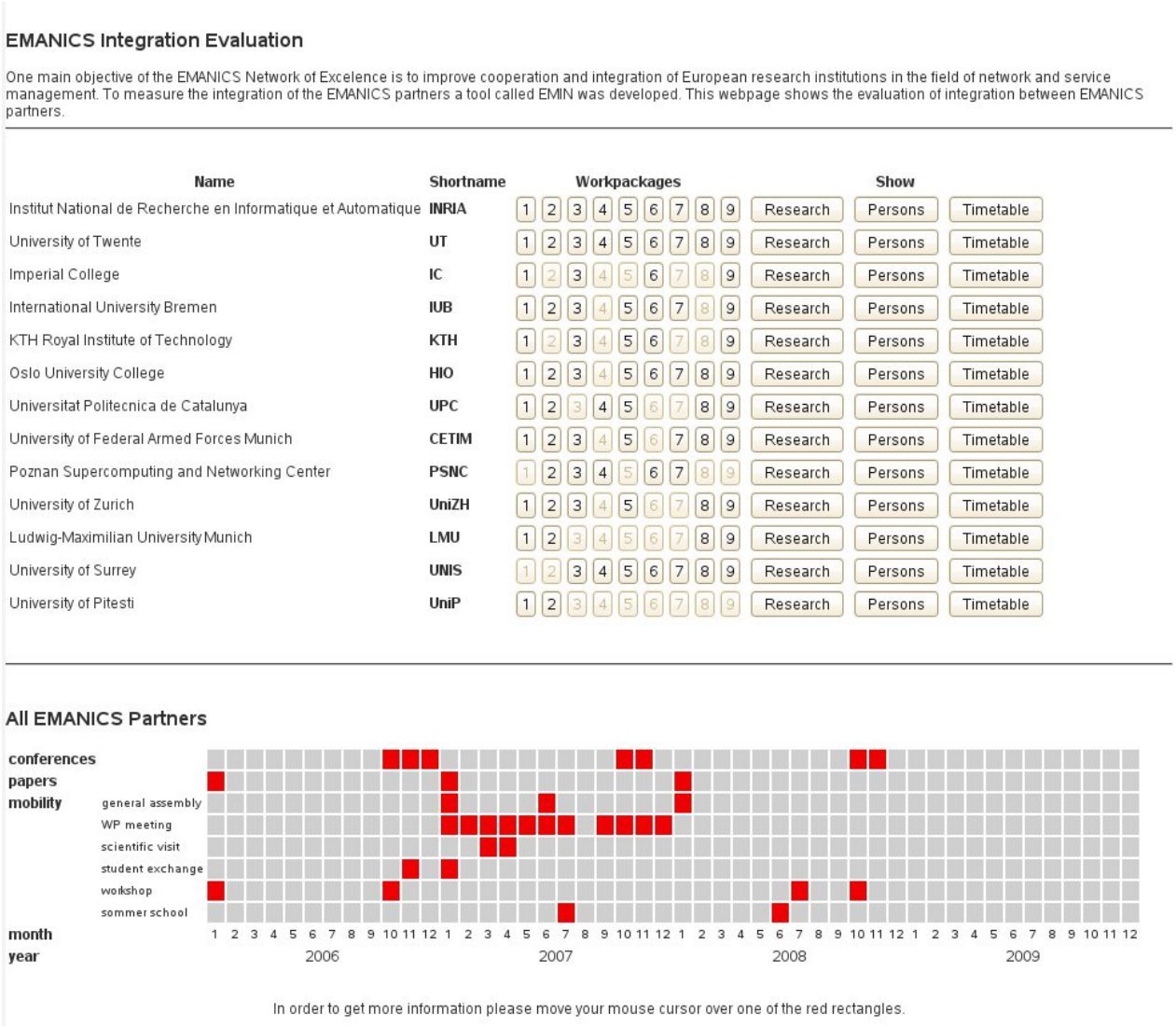


Figure 12: EMANICS Integration Evaluation

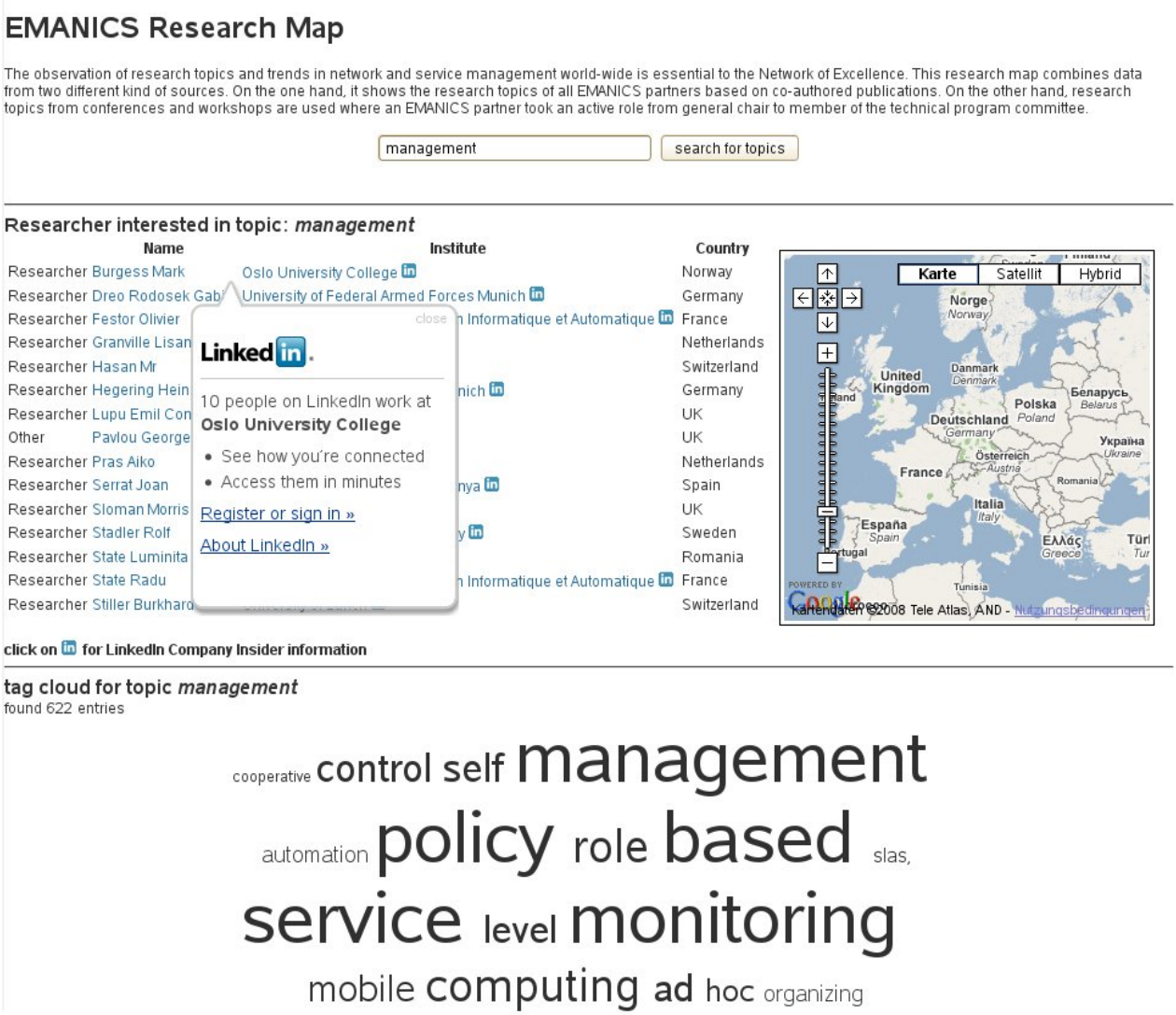


Figure 13: EMANICS Research Map

next to the institute's name. A further improvement of this tool is planned concerning the amount of imported sources for the tool as well as the expansion of the topic field. The user should get the possibility to define a precise topic filter so that the search for possible research topic partners gets more exact. The investigation on this topic filter will take part in further work.

6.1.5 Code Reusability

Both research map and EMIN tool source code are reusable for other projects with a similar project structure. Nearly all European supported projects are separated in work packages and have partners scattered over Europe. Thus, the "EMANICS Worldwide Research Map" as well as the "EMIN tool" should be usable for European projects with a minimal configuration effort.

In order to adapt the tools to other projects, adjustments in the central configuration script is needed. Here the number of work packages and other project details have to be given. The involved institutes, names of the researchers, and the linkage of the data to the work packages and so on, is saved in the database. Until now we have not implemented a tool for building the initial database, because our work is based on existing databases. Such a tool should inquire all relevant project information and build an initial database for the Worlwide Research Map and EMIN tool. Next to the opportunity to build an initial database, the tool could be integrated in an administrative tool in order to give the administrator the possibility to change information in the database. Such an administrative tool could be important for projects where it is not possible to import the relevant data from outer database sources automatically, like we have done this for the EMANICS-based tools in our project.

The frontend of the tools is programmed in the PHP script language as we have used JAVA programming language for the backend tools (automatic data import). The underlying database is MySQL but this is not mandatory, because PHP and JAVA interfaces for other database engines are available and widespread. The standard installation which is needed to run the tools covers a web server with PHP extension, database and JAVA runtime engine installed. It is also possible to split these services on several computers, if it is wanted. In this case, the configuration in the PHP script configuration file and in the JAVA tool configuration have to be modified.

6.2 Taxonomy

Within EMANICS WP1 a new and uniform management taxonomy has been developed. This taxonomy provides a list of keywords that authors can use to annotate papers submitted to journals and conferences in our area. Based on these keywords, the organizers of such journals and conferences can search through the list of topics that potential reviewers are interested in. In this way, a better selection of reviewers would be possible and the quality of reviews can be improved.

At this moment, no standard list of keywords in the area of management exists. In fact, each conference organizer proposes a new list of (topics) keywords, and requests each TPC member to express in which topics he or she is interested. The responses to such

requests are quite diverse. For NOMS 2006 25% did not react to this request (21 out of 87), for DSOM 2007 less then 10% (5 out of 58) and for NOMS 2008 nearly 20% (21 out of 111 reviewers) did not react. Since the list of topics changes from event to event, information from previous events can not be used for future events. Clearly a uniform list of topics would be a desirable feature to have. Such list can not only be used to better match reviewers to papers, but would also help to classify papers and analyse the changes in interest over time. This would help to better understand developments in our area.

Taxonomies are nothing new in the area of computing. The Association for Computing Machinery (ACM), for example, has created a two level classification system, which structures key terms like hardware, software and data at level one, and terms like computer-communication networks, software engineering, programming languages and operating systems at level two. The IEEE has adopted a modified version of this taxonomy. The problem with that taxonomy, however, is that only 3 management related terms have been included: network management, network monitoring and system management. This is clearly not sufficient to structure our research area. In fact, the taxonomy developed by EMANICS can be seen as 'zooming-in" into these high level ACM terms.

A key requirement for each taxonomy is getting accepted. For this purpose, the taxonomy developed by EMANICS has been presented to, and accepted by the key organisations active in the area of network and service management. These organisations are:

- IFIP WG 6.6: the taxonomy was presented, discussed and accepted at the joint IFIP WG6.6 and IEEE CNOM meeting. This meeting took place Tuesday, April 8th in Salvador de Bahia, Brazil.
- IEEE CNOM: see IFIP WG6.6
- IRTF-NMRG: the taxonomy was presented, discussed and accepted at the IRTF-NMRG meeting, which took place March 14, 2008, in conjunction to the 71st IETF Meeting, Philadelphia, USA

Another important factor for acceptance of the taxonomy by our community is the incorporation of this taxonomy within JEMS (Journal and Event Management System). In 2008 Emanics partners, in collaboration with the JEMS maintainers, worked on implementing our taxonomy within JEMS. This implementation is now ready, and will be used for our next major conference in our field: NOMS 2010.

6.2.1 How was the taxonomy developed?

The JEMS system was also the starting point for our taxonomy development. The first step was to identify all relevant conferences in our area. The second step was to get from all these conferences the list of topics. The third step was to structure, reorganize and integrate these list. For this purpose a top-down (decomposition of our area), as well as a bottom-up approach (how often has each keyword be used) was followed. The remaining list was than discussed and restructured within a small design team multiple times. At the General Assembly in January 2008 in Barcelona, the resulting list has been presented and further been discussed among all members of work package 1. Based on the refined

classification, various graphs have been generated reflecting relative number of papers and TPC members for the identified first-level terms as well as for second-level terms. Based on these insights, several conclusions were drawn indicating that the identified first-level terms properly capture in a balanced way the TPC members interests and authors papers and that some of the second-level terms may be too specific to cover some topics, as for instance the term ”SNMP”. In addition, several unclassified topics denote that some areas needed additional second-level terms to be covered more properly.

6.2.2 Overview of the taxonomy

The goal of our work was to define a more stable, two-level hierarchy of topics that defines the scope of the area. The first-level topics cover different dimensions of management. These dimensions include:

- What should be managed (e.g., networks, services)
- Which aspects should be managed (e.g., security, accounting)
- How it should be managed (e.g., distributed, centralized)
- How to implement it (e.g., which protocols?)
- Which techniques should be used (e.g., simulation)

The second-level topics specialize the first-level topics

The next list gives an overview of all keywords in our taxonomy.

1. Network Management
    - Ad hoc networks
    - Wireless and mobile networks
    - IP networks
    - LANs
    - Optical Networks
    - Sensor Networks
    - Overlay Networks
2. Service Management
    - Multimedia service management (e.g., voice, video)
    - Data service management (e.g., email, web)
    - Hosting (virtual machines)
    - Grids
3. Business Management

- Legal and ethical issues
- Process management

4. Functional Areas
    - Fault management
    - Configuration management
    - Accounting management
    - Performance management
    - Security management
    - SLA management
    - Event management
5. Management Approaches
    - Centralized management
    - Distributed management
    - Autonomic and self management
    - Policy-based management
6. Technologies
    - Protocols
    - Middleware
    - Mobile agents
    - P2P
    - Grid
    - Data, information, and semantic modeling
7. Methods
    - Control theories
    - Optimization theories
    - Economic theories
    - Machine learning and genetic algorithms
    - Logics
    - Probabilistic, stochastic processes, queuing theory
    - Simulation
    - Experimental approach
    - Design

6.3 Indexing DBLP

In 2008 UT and INRIA started an activity on monitoring and improving the indexing and visibility of the community's publications. The initial objectives has been to ensure that all publications in conferences within the scope of EMANICS (IFIP/IEEE IM, IEEE/IFIP NOMS, MANWEEK, AIMS, LANOMS) are accurate and visible through the widely accepted and used DBLP system. To this end, we went over all events since the creation of the community back in 1989 and created an overview of which conferences were already included, and which not. Subsequently we updated in coordination with the DBLP owner/administrator all recent IM and NOMS conferences. Most publications coming from these two events there are now fully referenced in DBLP and cross-checked with the various sources available (IEEE digital library, paper proceedings, ...). This significantly increases the visibility of the community, especially in these days where DBLP and other databases are used to establish bibliographic measures.

In addition to the update and integration of data from the past, we have initiated with IEEE and IFIP the procedures that allow future events of the community to be automatically integrated into DBLP. To this end we have had a series of interactions with many officials within the IEEE ComSoc organization. Good collaboration with the ComSoc president was very important for that purpose.

Figure 14 shows the status of conferences included into dblp. The green and yellow conferences are now included; the yellow ones were included only recently. The blue ones are the conferences for which EMANICS has already created the right input files for DBLP, but are not yet included due to the lack of Digital Object identifiers (DOI). The light red ones are currently being added, while the red ones are still missing. Some of these are very old, however, and it migth be quite hard to get the old proceedings. Note that some conferences are organised on a biyearly schedule; these years these conferences were not organized, is indicated in grey.

Conferences

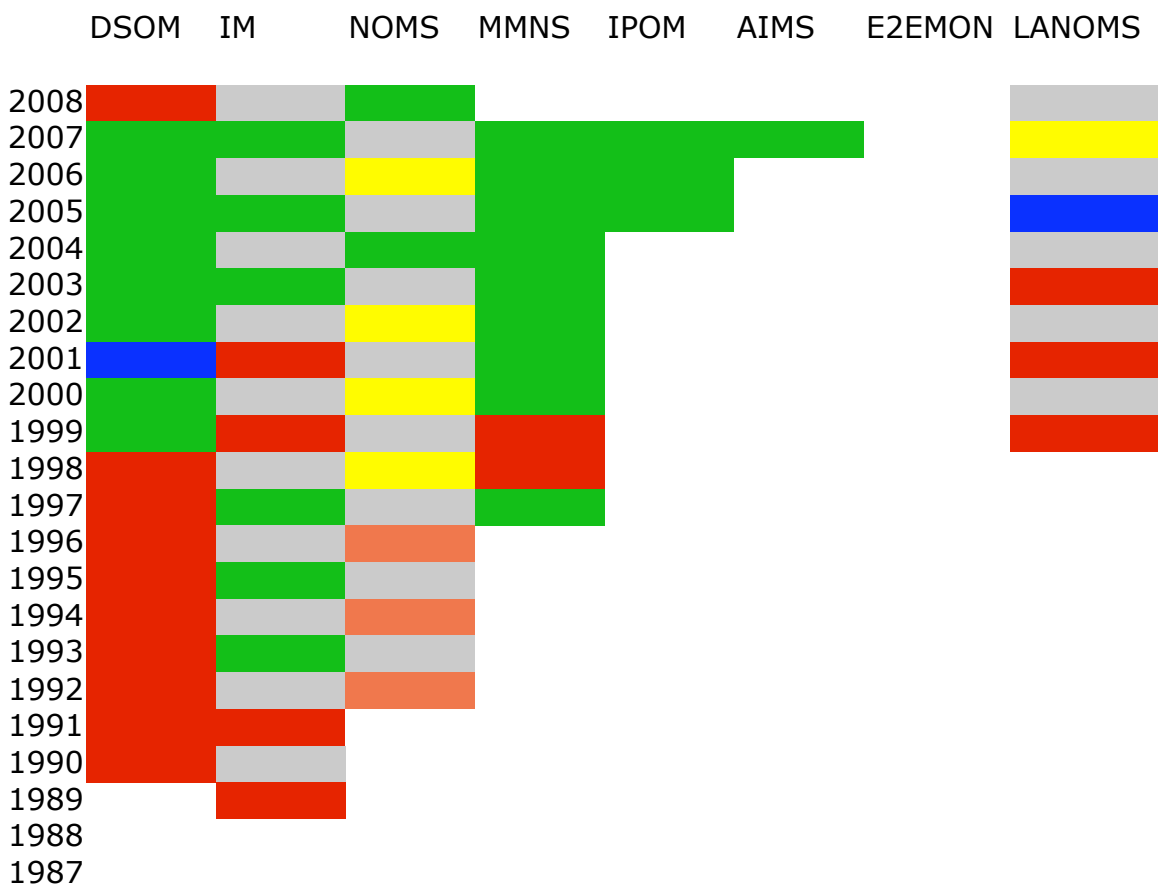


Figure 14: Management related conferences in DBLP - Status 31-12-2008

7 Conclusions

Deliverable D1.5 reports on the outcomes of the WP1 tasks in the last reporting period. It should be stressed that all activities have been performed very well. New teaching material has been developed for the common course program, and the visibility of EMANICS has been extremely increased due to the involvement of EMANICS in the Future Internet activities. New approaches of collaboration possibilities, like the analysis of social networks, and the impact on collaboration between IT researchers have been investigated as well. A lot of effort has been put also into the deployment and enhancements of EMIN, the EMANICS integration graphs. The current implementation has been extended with respect to automating the data acquisition as well as the evaluations as far as possible. The world wide research map has been enhanced with the objective to provide useful information about research topics also behind EMANICS. EMIN and the world wide research map are both deployed with the aim to provide code reusability, and thus could be used for other projects as well. Furthermore, the taxonomy of network and service management, as developed by EMANICS, has been presented and accepted by the key organizations, active in this area, namely IFIP WG 6.6, IEEE CNOM and IRTF-NMRG. This activity increased the visibility of EMANICS extremely as well. Last but not least, EMANICS's visibility has been increased as well with activity of indexing DBLP. EMANICS initiated together with IEEE and IFIP procedures that allow future events of the community to be automatically integrated into DBLP.

8 Acknowledgement

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References

[1] *The DBLP Computer Science Bibliography*, 2008. http://www.informatik.uni-trier.de/ ley/db/index.html.

[2] *JEMS - Journal and Event Management System webpage*, 2008. https://submissoes.sbc.org.br.

[3] The EMANICS Consortium. Research and teaching map report. Deliverable D1.4, EMANICS Project, March 2008.

[4] *Google Map API Concepts*, 2008. http://code.google.com/apis/maps/documentation.